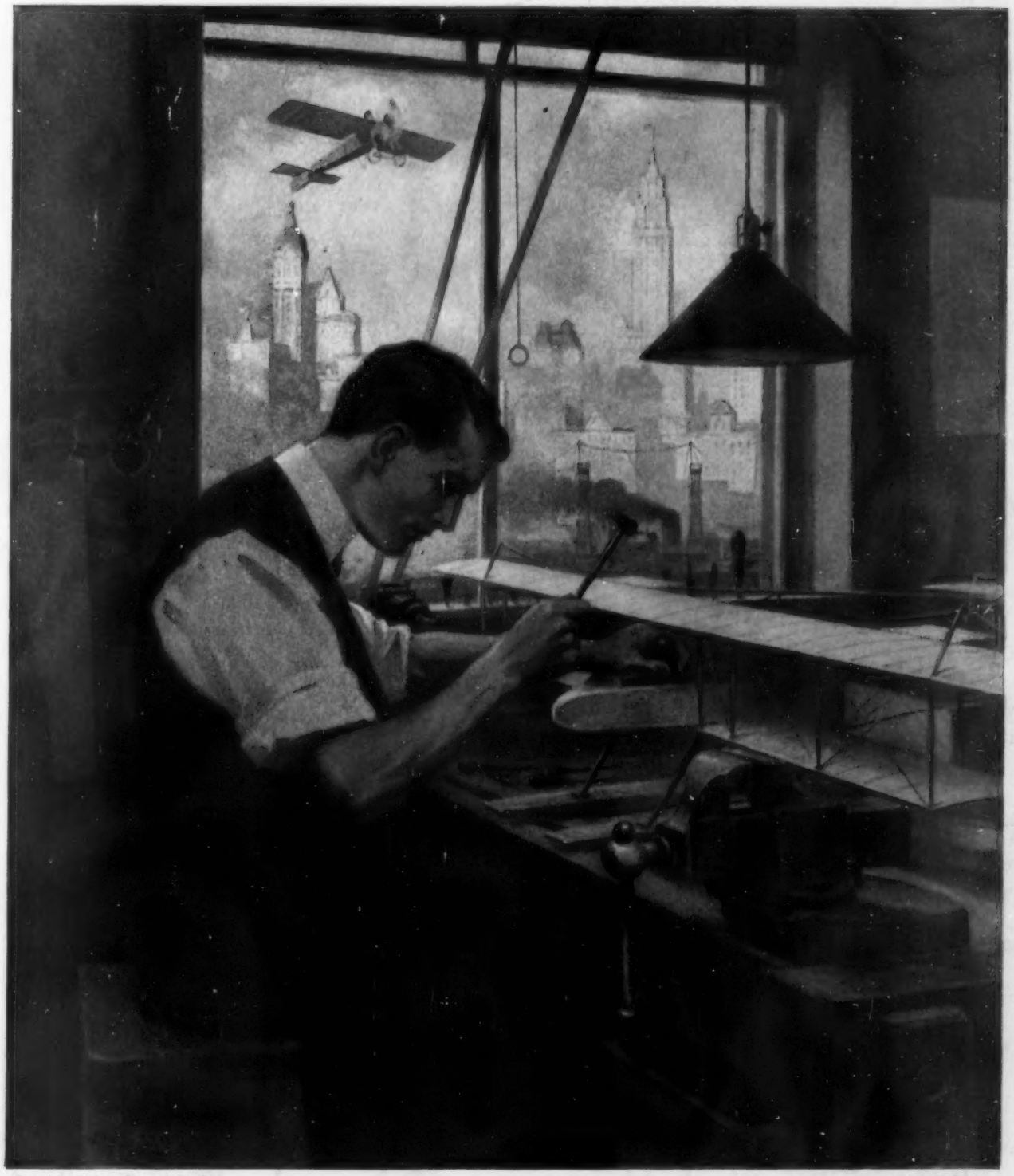
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION



From a Painting by Edwin H. Bayha

The Ten Greatest Inventions of our Time
Prize Essay Contest

Vol. CIX. No. 18
Nov. 1. 1913

Munn & Co., Inc., Publishers
New York, N. Y.

PRICE
15 CENTS

PACKARD TWO-THIRTY-EIGHT

The new model is ready for our patrons. It is the embodiment of Packard quality. You are invited to inspect these attractive features

WORM BEVEL DRIVING GEARS

Unequaled as a silent drive when installed in rear axle transmission. A new departure in mechanical development.

ONE MAN TOP

Can be raised or lowered by one man from a position in the car or on the ground.

ELECTRIC SELF-STARTER

An independent motor unit for cranking only. Spins the engine at one hundred revolutions per minute.

ELECTRIC LIGHTING GENERATOR

Independent dynamo with self-contained regulator, insuring at all times a properly charged battery.

SEPARATE MAGNETO IGNITION

Magneto for starting and running, with battery system in reserve. Greatest possible insurance against electrical trouble.

CENTRALIZED CONTROL

Every switch and operating adjustment on control board just beneath the steering wheel.

LEFT DRIVE

Avoids stepping into the street. Safest in traffic.

LEFT HAND GEAR SHIFT

Adds to the convenience of driving and avoids obstructing the front compartment of the body.

SHORT TURNING RADIUS

Car turns in a circle forty-four feet in diameter.

HYDRAULIC GOVERNOR

Helps to prevent racing or stalling the motor. Steadies the car in rough going.

FORCE FEED OILING

All engine bearings, including cam shaft, floated on a film of oil under pressure. Direct leads to cylinder walls feed oil to piston thrust surface when engine is working hard.

SEVEN BEARING CRANK SHAFT

Two and one-eighth inches in diameter. Held in seven bearings in heavily ribbed crank case. Contributes to smooth running.

DRY PLATE CLUTCH

Practically indestructible. Made of hardened steel discs and asbestos lining. Does not grab nor slip. Fitted with clutch brake of uniform resistance.

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Three speeds progressive on rear axle, permitting of the lightest and most flexible chassis.

WINDSHIELD

Packard folding design with rain vision. The most rigid and enduring windshield ever built.

STEERING

Worm and nut mounted on roller bearings. Easy and safe.

RADIATOR SPLASHER

Keeps radiator clean in muddy going. The motor is mud tight. Enclosed wiring, valves and oil passages make clean design.

GASOLINE TANK

Outside of the body on rear of frame. Not necessary to disturb a single passenger when taking on supplies. Tank is sealed tightly, avoiding odor or waste by evaporation.

REAR TIRE CARRIER

Removal of tires from running board permits access to the front compartment from either side.

FRAME

Six inches deep to give maximum service. The bridge builder's factor of safety embodied in every detail of Packard construction.

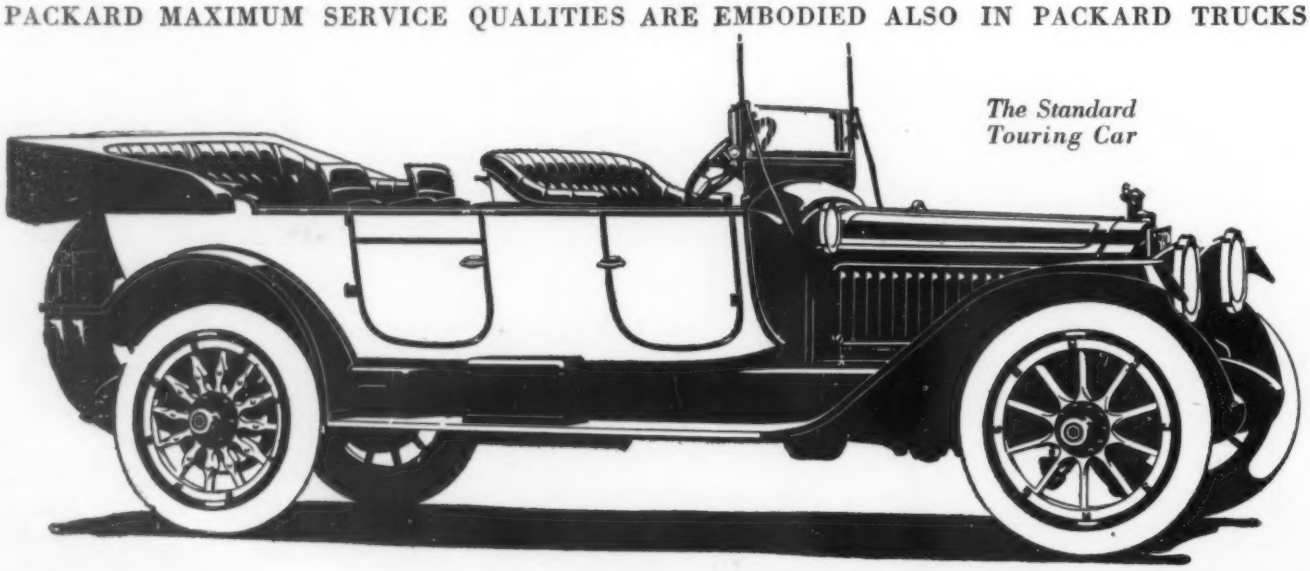
ACCESSIBILITY

Every important unit of motor, clutch, transmission, brakes and steering, readily accessible for cleaning, oiling and adjustments.

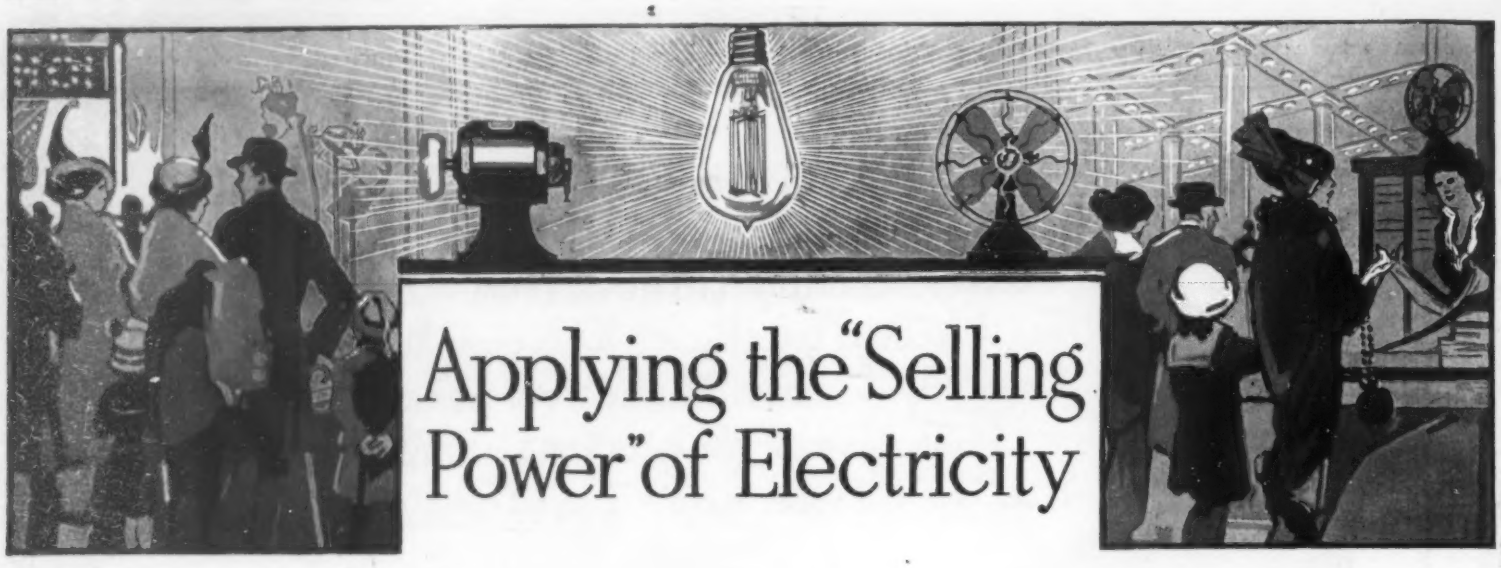
Packard Motor Car Company, Detroit

LINCOLN HIGHWAY CONTRIBUTOR

PACKARD MAXIMUM SERVICE QUALITIES ARE EMBODIED ALSO IN PACKARD TRUCKS



The Standard Touring Car



Applying the "Selling Power" of Electricity

TWO men stood in front of a department store in an Iowa town, and the younger one, speaking decisively to his companion, said:

"Masterson, I'm going to rip out that front. It's very respectable, and there is history behind it, but now that this property has descended to me, I think I can do most for my father's name by doing now what he did when he started—by striking out on up-to-date lines. We've fallen away behind the two other department stores. And there's good reason. See how gloomy the place looks—respectable but gloomy. The goods look dull. There's nothing to call people in, nothing to cheer them up and put them in a buying mood after they get in. We've got the goods, Masterson, and you're the best sales manager we ever had. But I've been around the country looking at the livest places, and I tell you that the best salesman of all is *Electricity*.

"I'm going to put in a new display arrangement and light up that new front so as to stop people as they come up the street. I'm going to make it invite them in. I'm going to light the whole interior so that every bit of floor space will have a real selling value. Good modern lighting will not only make the goods look interesting, will not only make people want to buy, but I tell you, Masterson, it will make the salespeople feel like selling. It will put ginger into the entire force.

"Then I'm going to open up for better ventilation at the back. I'm going to put in more electric fans—you'd be astonished to know how they freshen up the air in a place.

"Another thing: there are a thousand and one electrical devices—there's a good dozen for us anyway—that will transform our ways of doing business, put snap in it, make it smoother and more comfortable for the customers and ourselves. I'll be able to do a lot more work with the same people—and it's simply a matter of plain cause and effect that we'll forge ahead. We'll keep all our good traditions—and make some new ones."

This young man who had been "around the country looking at the livest places" held a conference with his architect, then called in an electrical engineer. He knew what he wanted done and wanted to learn how he was going to do it. This was a little over a year ago. Today that department store is doing 85% more business than it was doing on the day the new owner made his declaration, with only a 12% increase in its force, and has taken the lead in the volume of sales.

Maybe you who read this have retail selling problems that make it worth your while seriously to consider the kind of service you can get from electricity—the kind of service you can get from your outfit and your people with electricity to help.

Good light not only means more customers and more sales, but it means greater economy. Good light means more sales in all parts of the store—dark, unprofitable corners are banished—it means more frequent turning over of stock—more profit.

Good air means good working conditions, more productiveness for each human unit, and it means agreeable conditions that affect the customer happily in conjunction with the cheery power of good lights.

How these great advantages may be carried out in your case is a matter for the electrical man to lay before you. You will be astonished at the ease and the economy with which modern outfits can be installed and operated.

Take up the matter today with your electric power and light company, or any General Electric Company dealer or agent in your vicinity. You will find them more than glad to co-operate with you, and no matter how complex your problem may be they have at their command the service of any part of our organization that may be most helpful to them and to you.

The Guarantee of Excellence on Goods Electrical

GE

Trade Mark

GENERAL ELECTRIC COMPANY

Largest Electrical Manufacturer in the World

Atlanta, Ga.	Chattanooga, Tenn.	Elmira, N. Y.	Keokuk, Iowa	Memphis, Tenn.	Omaha, Neb.	St. Louis, Mo.
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For Texas, Oklahoma and Arizona business refer to Southwest General Electric Company (formerly Hobson Electric Co.)—Dallas, El Paso, Houston and Oklahoma City.
For Canadian business refer to Canadian General Electric Company, Lt'd, Toronto, Ont.

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SIXTY-NINTH YEAR

SCIENTIFIC AMERICAN

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The dynamite was set off by President Wilson, who threw the switch in Washington on October 10th, 1913.

OPENING A BREACH IN GAMBOA DIKE WITH FORTY TONS OF DYNAMITE.—[See page 342.]

SCIENTIFIC AMERICAN

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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

A Standard of Safe Railroad Travel

THE recent recurrence of fatal disasters on our railroads has once more raised the question of the relative safety of railway travel in this country and abroad. In looking for some standard by which to determine whether accidents are more frequent than they should be, it is perfectly fair to take the best results that have been obtained on some well-known system of operation. So, for this purpose, let us consider the official statistics published by the British Board of Trade, which show that during the ten-year period ending in 1909, on all the railroads of Great Britain and Ireland only one passenger was killed for every 72,000,000 carried, which is a rate of casualty that must certainly be considered as highly satisfactory.

With this as a standard, we turn to the last available annual official report of the Interstate Commerce Commission, which shows that 198 passengers were killed during the year 1910 on the steam railways of the United States, during which year the total number of passengers carried was 971,683,199. This means that in that one year one passenger was killed for each 4,900,000 passengers carried. Comparing these figures with the standard of safety set by Great Britain, we find that the rate of casualty in that country is less than one fourteenth as great as that in the United States.

In commenting upon these facts, *Engineering News* answers the objection which may be raised to the above comparison on the ground that the average length of a railway journey is much greater here than in Great Britain, by stating that the British statistics do not include journeys by holders of season tickets, and that this class of travel covers a very large proportion of the short-distance traffic. Assuming, says this authority, that the average of a passenger journey in Great Britain is only one third as long as that in the United States, there still remains an average casualty rate in the United States nearly five times as great as that of Great Britain.

For many years the SCIENTIFIC AMERICAN has drawn attention to such facts as these, and we have pointed out from time to time that the remarkable immunity from accidents in Great Britain is rendered the more remarkable by the fact that the density of traffic is much greater on the railroads of that country than it is on our own. It will be news to many of our readers to learn that on the 25,000 miles of steam railways in Great Britain and Ireland more passengers are carried per annum than on the 250,000 miles of railroad in the United States. Furthermore, foggy and misty weather, which renders it difficult to observe signals, is far more prevalent in Great Britain than here.

The admirable safety of British railway travel is due to two causes: First, the practically universal use of the absolute block signal system; secondly, the absolute obedience to that system required of the enginemen. Statistics show that as far back as 1881, five sixths of the double-track railway in Great Britain was equipped with block signals and that in 1894, 99.6 per cent was so equipped. The British engineman has been operating under the block system practically all his life; and he obeys its mandate. When the semaphore arm says stop, he stops, nor does he open the throttle until the arm has fallen. In this country we play fast-and-loose with our signal systems; on many roads, on most roads, in fact, the engineman after stopping at a signal which is against him, is allowed to proceed cautiously, feeling his way to the obstruction ahead of him. This tampering with the block signal system (we call it nothing less) is shown, furthermore, in the continuance of the inefficient and dangerous practice of back-flagging.

Railway travel in this country can be made as safe as it is anywhere in the world by installing the block system on every road, and by revising our rules of operation so that the signal indications shall be absolutely obeyed. Furthermore, in view of the fact that discipline has not yet reached the high standard which, alone, can render the best mechanical appliances fully efficient, the automatic stop should be installed as an effective preventive of disregard of signals.

Magnitude of the New Subway System

NOT many people realize the magnitude of the work which is being done in extending the subway system of New York. So quietly and unostentatiously is the new method of excavation being carried on, that the residents of New York are not confronted by any physical evidences of the really great magnitude of the undertaking, such as marked the construction of the first subway. Yet it is a fact that the building of what is known as the Dual System involves an expenditure of capital that is over one half as great as that which has been invested in the Panama Canal. The canal, when completed, will have cost about $375,000,000; it will cost $200,000,000 to construct the new city-owned subways.

The latest reports of the engineers of the Public Service Commission show that there is now under contract $83,000,000 worth of work on the new subway, and that the average daily force employed is 7,000 men. About two fifths, therefore, of this great work is already under way. Before the end of the year contracts to the value of about $60,000,000 will have been let, which means that nine months after the signing of the Dual System operating contract, actual construction work will be in progress on three quarters of the city-owned lines.

The total length of the new system will be about eighty miles, of which forty-five miles will form an extension of the present Interborough system and thirty-five miles will represent the New York Municipal system. These figures, however, cover merely the length of the road; and since the subway will consist of two-three- and four-track lines, the single-track mileage will be not far short of 200 miles.

Radio-telegraphy and Safety at Sea

THE fact that the burning steamer "Volturno" was able to summon to its aid by radio messages no less than eleven steamers, gave additional proof of the priceless value of this means of communication in the saving of life at sea. Not that any such further proof was necessary; for Marconi's great invention had already established its position as one of the most merciful aids to the saving of human life in all the history of invention.

It was inevitable that radio-telegraphy should hold a prominent part in the discussions of the International Conference on Safety at Sea, which is to be held in London, on November 12th of this year; and we note that Secretary of Commerce Redfield's committee on this subject has sent in a recommendation to the conference, which appears to cover the subject comprehensively.

The committee proposes that efficient apparatus for radio communication be required on all ships in foreign trade which carry fifty persons or more (passengers or crew, or both combined), navigating the ocean between ports more than 200 nautical miles distant from one another; and that apparatus, to be deemed efficient, must transmit messages with sufficient power to be received by day over sea, at a distance of at least 100 nautical miles, by a ship equipped with apparatus equal to that of the transmitting ship. It is further recommended that an auxiliary power supply should be provided, independent of the vessel's main electric power plant, which will enable the sending set for at least four hours to send messages over a distance of at least 100 nautical miles by day.

There is an echo of the "Titanic" disaster in the recommendation that two first-grade operators should be required on all such ships maintaining a constant service, also on all such ships carrying 100 or more passengers; that one first-grade and another first or second-grade operator should be required on all other such passenger ships; and that one operator (first or second grade) and one cargo operator or watcher should be required on all such cargo boats.

Chimerical Weather Forecasting

THERE has recently been a marked recrudescence of the unorthodox weather prophet. Though always abroad in the land, his activities fluctuate under the influence of several factors, one of which is the amount of advertising he receives through the efforts of scientific people to discourage him. In the present case he seems to have mistaken the recent house cleaning in the Weather Bureau, at Washington, for an indication that the national meteorological service has been professionally discredited and to think that the time has come for the unofficial forecaster to have his innings; or it may be that his present activity is merely the usual reaction of an abnormal mind to any strong impression of the moment, the impression in this instance being that produced by the unfortunate notoriety given a few months ago to Weather Bureau affairs. However this may be, an unprecedented number of more or less fantastic schemes for predicting the weather of to-morrow, next week, and next year have lately come to light, so that it seems timely to say a word on the general subject of unscientific weather forecasting—with the premise that we are dealing not so much with "fakes" as with delusions, though the former have figured largely in the history of this subject.

A weather prophet's confidence in himself is always in inverse proportion to his knowledge of the laws of the atmosphere. The intelligent meteorologist is the most modest of forecasters, for he realizes more keenly than anyone else the endless complexity of the phenomena with which he has to deal, and the extent to which his conclusions are likely to be vitiated by unknown factors in the problem. His facilities have been much improved in recent years by the broadening of the weather map, on which alone rational predictions can be based. At Washington a map is drawn every morning showing the meteorological conditions, reported by telegraph, at a chain of stations extending around the globe. With the aid of this map predictions are now made, in very general terms, for a week in advance. Nevertheless, scientific weather forecasting is still an unsatisfactory process, so far as it relates to the ordinary fluctuations of heat and cold, rain and sunshine, though it fully justifies its existence when it comes to deal with such definite and momentous occurrences as storms and cold waves.

The undeniable imperfections of legitimate forecasting encourage the activities of the charlatan and the crank. Though the latter may be an honest ignoramus, there is usually enough method in his madness to enable him to find a lucrative market for his prognostications. He is supported by the same public which enriches the publishers of grossly unscholarly lexicographical works, obsolete atlases, and the like, and his happiest hunting ground is the United States of America. It is said that certain prognosticators earn incomes of from five to ten thousand dollars a year by the sale of their predictions to newspapers and almanacs. Most of these predictions are of the "long-range" variety; i. e., they are made up for a year or more in advance.

In the typical case, the prophet (when he is not a deliberate fraud) is a man who has not sufficient intellectual stamina to pursue the long and rugged road of scientific investigation, but who fancies that by a peculiar dispensation of Providence he has hit upon a short-cut to the truth. Moreover, the particular mare's nest discovered by one of these persons has usually been discovered by a great many others; so that the "systems" of the pseudo-scientific forecasters fall into a few well-defined classes. By far the most numerous group of prognosticators ascribe supreme influence in meteorological matters to the moon. Another group stakes its reputation on sunspots. Some years ago the hypothetical planet "Vulcan" was a favorite with these seers. Others exploit that perennial refuge of ignorance—electricity. And so on.

The reputation of the forecasters—perhaps even of the scientific ones—with the mass of humanity is saved by the fact that, with our changeable weather, even the wildest predictions must frequently hit the mark. Moreover, if a change in the weather predicted for to-day fails to materialize it is likely, in the ordinary course of nature, to come to-morrow, and the slight delay in the verification of the forecast is apt to be viewed indulgently by the public.

Weather forecasting as a private commercial enterprise is, on the whole, more lucrative and dignified than fortune-telling, and does not, as yet, come within the purview of police and post office inquisitions.

Propolis for Surgical Dressings.—The resinous substance collected by bees from the buds of trees and used by them to stop up crevices in the hives, has just received a novel application in surgery, according to *L'Illustration*. When this viscous substance is distilled in the crude state there is obtained a brownish liquid of unctuous consistency known as propolisine. When this is applied, either pure or mixed with 25-30 per cent of vaseline, to the surface of a clean wound, this is covered with a sort of isolating varnish which has an immediate soothing effect and in whose protection healing takes place under the best conditions. MM. Parvel and Meyer, who have been experimenting with it, affirm that it is very useful in surgery and when used on battle fields generally prevents septic and infectious complications.

Engineering

Filling Miraflores Lake.—The formation of Miraflores Lake began October 1st, when a bulkhead was placed across the drainage culvert in the spillway dam. It is expected that the lake will be full to the top of the spillway dam on November 4th, and to the normal operative level of 55 feet above the sea by December 4th. Should it be desired to fill the lake earlier, the water may be drawn from the high level of the Gatun Lake and Culebra cut through the culvert of Pedro Miguel locks.

Creosote as a Preservative of Telegraph Poles.—It is estimated by the Canadian authorities that every year some 600,000 telegraph and telephone poles have to be replaced because of their decay. Untreated red cedar poles last for 10 years; if the creosote is put on by the brush, they last 13 years; if they are tank-dipped they last 20 years. White cedar has a life respectively of 14, 17 and 22 years, according to the treatment, and yellow pine, 13, 15 and 20 years. It is estimated that creosote treatment would save upward of 260,000 poles per year.

Increased Use of Locomotive Superheaters.—There was recently held at Cassel-Wilhelmshöhe a celebration to commemorate the equipment of the 25,000th locomotive with the Schmidt system of superheating, which has now become a standard and increasingly popular feature of locomotive practice. Dr. Schmidt's first superheater to be applied to locomotives was installed in 1898 on some engines of the Prussian State Railways. Schmidt's pioneer work and its success encouraged competition. By 1910 some 5,000 engines had been equipped; 10,000 by 1911, and 20,000 in January, 1913. To-day the figure stands at 25,000.

The English Channel Tunnel.—The recent conference on Franco-British traffic has further stimulated the awakened interest in the proposed tunnel beneath the Straits of Dover. It is proposed to build two parallel tunnels, which will vary from a straight line in order to remain all the way in the impervious gray chalk. The landing points will be to the west of Calais and to the west of Dover. On the French side, connection will be made with the Chemin de fer du Nord, and with the South Eastern Line in England. Drainage headings will be run from the lowest point in the center of the tunnels to the shore on either side. Parliament is shortly to be asked to sanction the undertaking.

Traffic Over the Forth Bridge.—In the first year of operation of the Forth Bridge, from March, 1890, to March, 1891, there crossed over the Forth Bridge 37,610 trains of a total weight of 9,941,612 tons. In the year March, 1912, to March, 1913, there crossed the bridge, 62,944 trains, an increase of 40 per cent, while the total weight increased to 15,894,410 tons or about 60 per cent. This bridge still remains the largest of its kind in the world. It has two spans of 1,710 feet each, the next longest span being that of the Brooklyn Bridge, which is 1,595 feet, while the Williamsburg Bridge measures 1,600 feet between towers. Those two last named are suspension bridges and the Forth Bridge is a cantilever structure.

The Largest Wood-stave Pipe.—The Northwestern Electric Company of Portland, Oregon, has recently built for the conveyance of water what is, so far as we know, the largest wood-stave pipe yet constructed. It is 13½ feet in diameter, one mile in length, and it serves as the flow line from the dam to forebay. According to details given in the *Engineering News*, there are ninety-four 4-inch staves around the circumference, the normal length of which is 18 feet. The construction of the pipe called for over 1,600,000 feet board measure of Douglas fir, consisting of 1,000,000 feet in the pipe proper, 476,000 feet in the cradle and 210,000 in the mud sills. The staves were laid without tongue or groove, there being a steel dowel plate in one end of each stave to make tight the butt joints. The pipe was laid upon a bed of solid ground and, to stiffen it against distortion, it was carried in supporting cradles which were spaced four and one half feet apart on tangents, the saddles being carefully cut to shape.

Relegated to the Second Class.—The recent statement in the daily press to the effect that the North German Lloyd Steamship Company is about to retire the "Kaiser Wilhelm der Grosse" from its express service, and that it will rename the vessel and rebuild it for second and third class and steerage traffic, removing the first cabin accommodations altogether, serves to remind us how the transatlantic flyers of one decade become the second class ships of a later day not far removed. Transatlantic travelers will recall the time when this favored ship made her first appearance, and by covering the passage at an average rate of 22½ knots an hour, wrested the so-called "blue ribbon of the Atlantic" from the "Lucania" of the Cunard Line, which had raised the record to 22.01 knots average for the whole trip. A similar reconstruction and reassignment of duty occurred two or three years ago, when the 23½-knot "Deutschland," another record holder, was transformed into the cruiser "Victoria Luise."

Electricity

Extension of the Pennsylvania Railroad Electrical Zone.—It has been announced that the Pennsylvania Railroad will extend its electrified zone to Elizabeth, N. J. This is a step toward the electrification of the entire New York division, which will probably be accomplished within the next few years.

Wired Dwellings for Rent.—An enterprising electric light company in Muncie, Indiana, is advertising houses for rent which are wired for electrical conveniences, the idea being to keep wired property occupied, which of course is to the interest of the company that supplies electric light and power. Another object is to induce owners of property to wire their houses.

The Emergency Force on Holidays.—The electric light company of Marion, Indiana, has experienced considerable difficulty in securing a force of repairmen to re-establish service interrupted on Sundays and holidays. The difficulty has now been overcome by requiring the repairmen to telephone to the central station their whereabouts as soon as a storm breaks out. In case of any interruption, the manager may then collect a sufficient crew of repairmen in a very few minutes.

Electric Locomotive for the Canadian Northern Railway.—Orders have just been placed for seven locomotives and eight multiple unit motor car equipments for the Canadian Northern Railway terminal in Montreal. The locomotives and motor cars will use direct current at 2,400 volts. They will be equipped with two commutating pole machines in series with 1,200 volts across each motor. Electrical energy for operating the locomotives and motor cars will be received in the form of 3-phase, 60-cycle, 11,000-volt current, which will be transformed by motor generator sets to 2,400 volts direct current. Each locomotive will weigh 80 tons.

Ozonized Chicks.—A poultry man of Waltham, Mass., says the *Electrical World*, is using electric ozonizers to reduce mortality in the hatching and brooding of chicks. Ordinarily 24 to 40 hours elapse from the time the first chick peeps forth from its shell until the last one appears. But the use of ozone invigorates the chicks as indicated by a recent hatching which came out in ten hours. Furthermore, the chickens are uncommonly strong and robust. Experiments are now being extended to purify the hen-poisoned ground of the brooders in an attempt to save a portion of the 50 per cent mortality which occurs after the young chickens are hatched.

Searchlight on an Observation Tower.—The "Fast Mail" leaving St. Paul and Minneapolis every evening for Chicago carries a search lamp on the observation platform of the last car. This illuminates the landscape along the line which parallels the Mississippi River for over a hundred miles, and gives the passengers a very pleasing outlook. The search lamp is used on the 60-volt train lighting circuit and takes 20 amperes. The electrodes are placed horizontally, and after being focused they are kept in adjustment automatically. The lantern which is 13 inches in diameter stands on a pedestal about four feet high, and takes up 16 square inches of the floor space of the observation platform.

Passing of the Belt.—In a paper read before the American Institute of Electrical Engineers at Philadelphia, Charles Fair discussed the passing of the belt, and showed how that most dangerous piece of mechanism in the factory is being displaced by the individual motor mounted on the machine. In considering the improvement brought about by the electric motor in the factory one should credit it not only with a great saving in power, but also with a great reduction of injuries to employees. Although America was the pioneer in motor-driven machinery, it seems that Germany is showing more progress in this line. Nearly all machines in Germany are now direct motor driven.

The P. A. Y. E. Car in England.—At a recent conference of the Municipal Tramways Association at Sheffield, England, a paper was read on "pay-as-you-enter" cars. Referring to this paper editorially, the *Electrician* (London) says: "The policy of the American tramway authorities is to look upon every passenger as a thief, and every conductor as a thief until the contrary is proved. Thus it comes about that many ingenious methods have been devised in the United States for rendering absolute the certainty that every passenger shall pay his fare, and every conductor shall turn in all the money he collects." However, after thus superciliously referring to American practice, it admits that the experience with cars of this type at Leicester has been satisfactory, which would indicate that the American policy is not so bad after all, also that British conductors and traveling public are not all over-scrupulous in their dealings with the public service corporation. There are some objections, however, to the use of P. A. Y. E. cars in Great Britain, owing to the complication of their fare system. In Glasgow, for instance, there is one route where the fares range from ½d. to 7½d. and there are 47 overlapping ½d. stages.

Aeronautics

This Airship Can Pick Up Its Stores.—In patent No. 1,070,197, to Charles Scott Snell, of London, England, an airship is provided with a grapple device suitably connected to a winding apparatus carried by the airship and a suitable carrier for a load, all so arranged that the load can be picked up by the airship during its flight without severe shock.

Launching a Parachute by Power.—Daniel W. Adams, of Glendale Springs, N. C., has secured patent No. 1,069,662, in which a parachute has a tubular stem which forms an outer shell and is adapted to serve as a motor cylinder. A source of motive power is connected with the interior of the tubular stem and controlled in order to launch the parachute safely.

American Aerodynamic Experts to Study Abroad.—Assistant Naval Constructor Jerome C. Hunsaker, U. S. A., and Prof. Zahm of the Smithsonian Institution, formerly connected with the Catholic University at Washington, will soon go abroad with a view to investigating recent foreign developments in aviation. Mr. Hunsaker has been detailed for duty at Boston preparatory to his assuming charge of an aviation course.

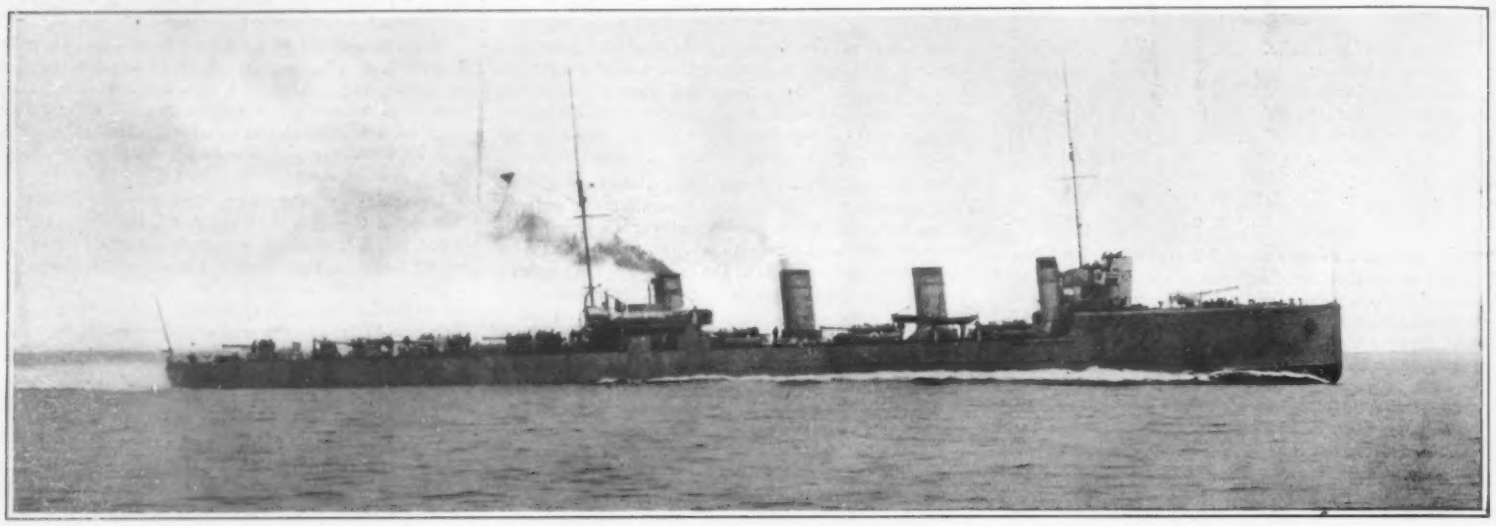
A Parachute Attachment for Aeroplanes.—Joseph A. Steinmetz of Philadelphia, Pa., has patented, No. 1,067,559, an aeroplane which has a transverse frame to which the planes are fixed and a frame transverse to the first frame with a parachute stowed at substantially the intersection of the two frame members and connected by tension devices with the ends of the frame members. The parachute is liberated by means under the control of the operator.

An Aeroplane Stabilizer.—Henry C. Fisk of Stafford, Conn., has secured patent No. 1,072,710 for stabilizer for aeroplanes, in which a stabilizing plane is arranged above the supporting plane and has a central portion surrounded by an upwardly and outwardly extending rim, making the stabilizing plane in the form of a dish with a flat central portion. The patentee claims that experiments have shown that the stabilizer will return an aeroplane to an even keel no matter what position the aeroplane is when it is launched in the air, provided the height at which it is launched is sufficient to give the stabilizing plane time to perform its function.

Aeroplane Radio Equipment.—The United States Government has been quietly but steadily carrying on a series of experiments with wireless apparatus on aeroplanes. The Signal Corps wireless messages have been sent from a height of 1,500 feet and received at a station almost 15 miles away, while other messages have been taken easily from machines 2,500 feet in the air. The radio equipment used weighs complete about 75 pounds and has a radius of 30 miles. The electric generator is friction driven from the flywheel of the engine and has an output of one eighth of a kilowatt. The antenna is of the hanging type, the wire being wound on a reel when not in use.

Aeronautical Meteorology in France.—The first meeting of the commission organized under the auspices of the Meteorological Society of France to study the relations between aeronautics and meteorology was held in Paris May 30th, under the presidency of Col. Rénard, and was attended by representatives of the Ministry of War, the Central Meteorological Bureau, and the principal aeronautical clubs of France. The commission voted to publish an account of the sources of meteorological information available for aeronauts, and passed a resolution in favor of the establishment in France of a network of pilot-balloon stations similar to those constituting the aeronautical weather service of Germany.

Exploration of New Guinea by Airship.—The plans of Lieut. P. Graetz for exploring the interior of New Guinea by means of an airship, brief mention of which has already been made in these columns, have now made material progress, a committee having been formed in England and Holland to finance the undertaking, which is expected to cost about $750,000. Designs for the airship have been drawn in Berlin. It will be 320 feet long by 60 feet in diameter, will be able to rise, under normal conditions, to an altitude of about 12,500 feet, and will make a maximum speed of 34 miles an hour. It will be equipped with two 100 horse-power motors. The base of the expedition will probably be Malu, where a base has been established by the Sepik expedition, now in the field. A portable shed for the airship and a gas-generating plant will be set up at this point. A series of trips will be made from the base, in each case to some previously selected point on the coast, which can be reached in one day. Another base station will probably be established for the exploration of Dutch New Guinea. As pointed out in *Petermann's Mitteilungen*, this project not only gives promise of securing, with the aid of such instruments as the aero camera and the photoperspectrograph, more rapid and effective surveys of the interior than are possible by ordinary methods, but also of furthering ordinary terrestrial explorations by aiding in the establishment and provisioning of stations in places now difficult of access.



Length, 326.9 feet. **Beam,** 31.4 feet. **Draught,** 10 feet. **Displacement,** 1,280 tons. **Effective Horse-power,** 36,500. **Mean speed on six hour trial,** 36.2 knots. **Mean speed on measured mile,** 37 knots.

Russian 37-knot destroyer "Novik," the fastest sea-going vessel afloat.

Fastest Vessel in the World

By Our Berlin Correspondent

THE world's fastest seagoing vessel has recently performed its trial runs. According to German press notices, the Russian torpedo-destroyer "Novik," built in the shipyards of Messrs. Vulcan-Werke, in connection with the official trial on the measured mile, with her trial load, has reached a mean speed of 37 knots, the maximum speed being 37.3 knots per hour. Some days afterward, the vessel underwent the continuous six hours' trial provided by contract. The speed prescribed for the trial, viz., 36 knots, was not only reached, but exceeded considerably, a mean speed of 36.2 knots, throughout the six hours, and a mean speed of 36.8 knots during the last three hours being obtained. The engines and boilers, in spite of these high speeds, never were pushed to the limits of their capacity, and no smoke issued from the funnels of the boilers, which were fired exclusively with liquid fuel.

The "Novik" is a turbine-propelled vessel. The following gives some of her main data:

Length between perpendiculars	326.9 ft.
Maximum breadth	31.4 ft.
Displacement	1,280 tons
Draught	10 ft.
Engine output	36,500 eff. horse-power
Contract speed	36 knots
Crew	140 men

The "Novik" mounts four 4-inch rapid-fire guns and four torpedo-tube sets. She is the only vessel of her class; but Russia is building eight destroyers of 1,050 tons and 34 knots speed.

The Most Rational Source of Power

Tapping the Sun's Radiant Energy Directly

SCIENTISTS have known for many years that mechanical power to any desired amount can be obtained from the rays of the sun, and have measured this power very accurately, but owing to its diffuse nature, its collection for practical purposes presented very many difficulties.

Some seven years ago, Mr. Frank Shuman of Philadelphia attacked this problem seriously with a well organized force, and the backing of men of means, and has now in operation at Cairo, Egypt, a very practical and profitable irrigation plant, deriving its power entirely from steam generated from water by the rays of the sun. This plant has now been running steadily since June, pumping water at a rate sufficient to irrigate over a thousand acres of land.

The first trials were made on a very small scale. Material after material, idea after idea was tried. By a process of elimination and addition and a gradual increase in the size of the trial plants, a practical method of using sun power was finally worked out. Each factor entering into the problem was thoroughly investigated, and one difficulty after the other being overcome, finally the plant now in successful operation in Egypt resulted.

The complete Shuman sun power plant as it was set up in Egypt for a test under tropical conditions.

Sun heat absorber which catches the sun's rays upon mirrors and concentrates them upon the long boiler in the center.

View showing the irrigation of land by sun power.

Looking into one of the absorbers from steam dome end.

Sun power plants once constructed, of course, dispense with all fuel, while in order to be practical and commercially profitable, they must conform to the following requirements:

1. They must not cost so much to construct that the interest on the cost over and above that of a coal burning plant of equal capacity will annul the profit made by the saving of cost of the fuel.

2. They must be constructed of such material and in such a manner that few repairs are needed, and so that they will last very many years.

3. They must be constructed strong enough to stand the heaviest gales that may occur in the localities where they are erected.

4. They must be sufficiently simple for anyone capable of running an ordinary coal burning plant to be able to run them.

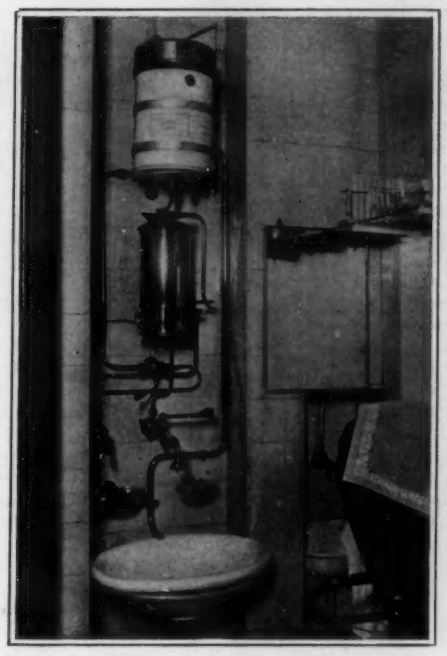
The present Egyptian plant fulfills every one of these requirements. Its cost is kept down to reasonable limits by constructing the entire frame-work of the heat absorbing portion of the plant out of simple structural pieces, all of similar design, and formed quickly and cheaply by ordinary machinery. The mirrors are made of ordinary window glass, silvered and protected in a special way, and cost only 5 cents per square foot. The foundation posts are of concrete and made in place. As far as the engine, pump and auxiliaries are concerned, these are the same as in any good coal burning steam plant, except that the cylinder of the engine is larger, owing to the fact that low-pressure steam is used. The heat absorbers and steam generators are constructed entirely of concrete, steel and glass—all materials which will last for very many years in the tropics. The iron being easily accessible can be painted every six or eight years. The heat absorbers are all constructed to stand safely a wind pressure of 30 pounds per square foot—more than that caused by any gales occurring in these portions of the tropics.

The sun power irrigation plant consists of the heat absorbers, five in number; a low-pressure reciprocating condensing steam engine of 100 horse-power, a reciprocating pump, and all the necessary auxiliaries.

As the entire engine and pump portion of the plant is practically identical with those of ordinary coal burning plants, except that the engine is specially invented and constructed so as to run very economically on low-pressure steam (for a description see SCIENTIFIC AMERICAN SUPPLEMENT, July 12th, 1913, p. 29), we will confine ourselves to a description of the sun heat absorbers and steam generators, which will take the place of the boiler, furnace and stack of the coal burning plant.

(Concluded on page 350.)

Ordinary electric lights are not suitable for the application of ultra-violet rays. Specially constructed lamps are designed and operated for that purpose.



View of an ultra-violet ray apparatus intended for use in sterilizing water in a physician's office, an operating room of a hospital, or other places for treatment of patients.

When the human skin is exposed to sunlight the ultra-violet rays penetrate and cause a dissociation of some of the chemical substances in the blood and tissues.

How Inventors Use Ultra-violet Rays

Making the Invisible Radiations Do Man's Work

IF one were to take a trip 8,000 miles long in perfect darkness all the way except for a distance of one inch, for which short distance the way was brilliantly lighted, would it be supposed that one would gather a very good idea of the country and scenery traversed? In the imaginary trip one would be under the same disadvantage that scientists have been in exploring the universe about us; for up to within recent years practically all observations of physical phenomena have been made by visible light. But visible light is only a very very small part of all the vibration of the ether, the medium in which light is propagated. For our physical senses can comprehend only a very small part of the vibrations which are continually crossing the ether around and through us. In fact, the lighted strip of one inch in comparison to 8,000 miles is a fair proportion of visible to invisible rays.

In the appended table is seen a diagram of wave-lengths and the phenomena with which they are most commonly associated.

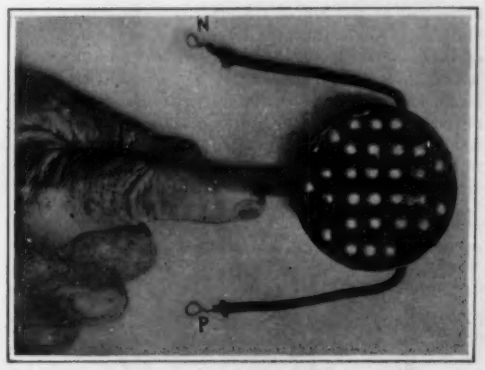
LIGHT WAVE TABLE.

Heat rays.	(a) Hertzian waves: Wave length from 6,000 meters down to less than a centimeter.	
	(b) Infra-red rays: W. L. from 20 microns down to about 0.8 micron.	
	Heat Radiations.	
Chem. active rays.	(c) Red rays, W. L. 0.71 micron.	
	(d) Orange, W. L. 0.66 micron.	
	(e) Yellow, W. L. 0.62 micron.	
	(f) Green, W. L. 0.53 micron.	Visible rays.
	(g) Blue, W. L. 0.49 micron.	
	(h) Indigo, W. L. 0.41 micron.	
	(i) Violet, W. L. 0.38 micron.	
	(j) Ultra-violet or cathode rays, W. L. 0.21 micron. Rays investigated by Weideman, Crooke, Leonard.	Finsen rays.
	(k) Bi-Ultra-violet, W. L. 0.1 micron.	Radium, uranium, polonium.
	(l) Tri-Ultra-violet or Roentgen rays. W. L. 0.014 micron.	X-ray and radiograph work.

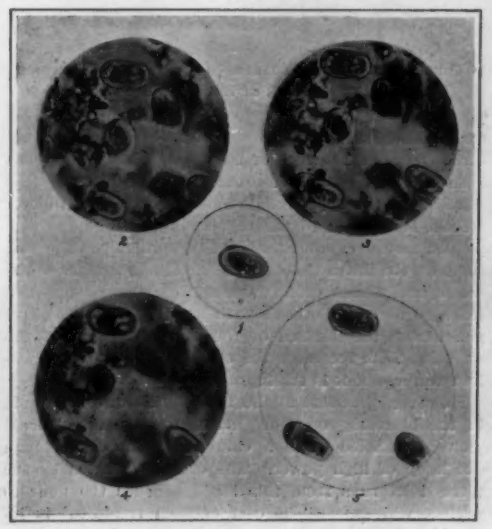
Now as indicated on the diagram, the upper rays of longer wave length are heat waves, and the lower ones of shorter wave length are chemically active rays. These shorter rays below violet are known as ultra-violet or chemical rays, and it is with those that we are at present interested.

The light from the sun contains all the rays in various proportions from the infra-red marked (*b*) to and including the ultra-violet rays marked (*j*) on our table. That is, the light of the sun as it strikes the earth contains all these rays. It is altogether possible and most likely that the sun gives all these various radiations and possibly others, but it is not possible to determine this as a fact for the waves may be of such slight intensity that they do not reach us in sufficient quantity to be admeasurable. Ultra-violet rays are very quickly absorbed by the atmospheric gases, and it is only a comparatively small part of the ultra-violet light that is given off by the sun that ever reaches the earth's surface, but the rays that do reach the earth play a very important part in the welfare of the biological inhabitants of the earth.

One fact determined when the properties of ultra-violet rays were first investigated was that the ultra-violet rays have a stimulating effect on plant and animal life, and as early as 1870 an experimental hothouse, using windows of blue and violet glass was built by Augustus I. Pleasanton of Philadelphia. He used various proportions of blue and of white glasses to determine the best conditions of growth for plants and animals. Although his efforts were along lines of correct theory, still he did not know that both ordinary lead and flint glass are almost totally opague to ultra-violet rays. In effect the arrangement merely shut off a certain per cent of both heat rays and ultra-violet rays, and the experiments, though interesting, were not conclusive.



Ultra-violet ray electrode designed by Dr. Charles F. W. Horn.



Spores of Nosema bombycis (silk worm). Photographs made by ultra-violet rays.

In more recent years the United States Department of Agriculture has carried on very extensive and exhaustive experiments along the same lines. The results obtained from these experiments brought out the fact that the ultra-violet rays are a stimulus to plants, especially at certain stages of their growth. However, the light does not have the same effect upon all vegetation and in some cases certain plants were greatly aided by the light, and in the same light the growth of others was retarded. The light for these experiments was obtained from mercury vapor and lamps, for the incandescent vapor of mercury is peculiarly rich in ultra-violet rays. In regard to the effect upon plant life in general, the first thing to notice is that ultra-violet rays have a strong chemical effect and are the part of the light of the sun which is very necessary for the life of the plant to enable it to breathe. The green chlorophyll in the leaves and growing stems is the chemical substance, which, under the influence of these chemical, actinic or ultra-violet rays, dissociates the carbon dioxide in the atmosphere into its elements carbon and oxygen. The plant absorbs the carbon and the leaves exhale the oxygen. Plants in the absence of chemical rays of light soon turn pale, because of their inability to absorb and convert the atmospheric carbon dioxide which is a vital part of their nutriment. At present it is not practical to aid ultra-violet rays artificially since they are costly and difficult to apply. Ultra-violet rays if generated by electric light must be very powerful to be of any effect, as these rays are quickly absorbed by the air, and very little of this form of light reaches the plant unless it is near the source. Ordinary mercury arc lamps are not suitable as it is difficult for the rays of short wave length to pass through the glass bulb. Specially constructed mercury arc lamps with quartz sides are very good for propagation of waves of short length. But at present such installations to stimulate plant growth are too costly to be of broad commercial value.

The effect upon animal life is somewhat different. Ultra-violet rays are very deadly to micro-organisms and bacteria. Upon animals of higher order the light seems to have a very beneficial effect as the more highly developed automatically adapt themselves to the light and soon protect themselves from the effects of ultra-

violet rays. This is the well known sunburn and tan which is Nature's protection against chemically active light. When the human skin is exposed to sunlight the ultra-violet rays penetrate and cause a dissociation of some of the chemical substances in the blood and tissues, this causes pain and inflammation. The effect is that a layer of pigment is soon deposited in the skin which acts as a screen to these chemical rays, preventing further damage.

Ultra-violet rays are very deadly to all bacterial life and are of especial use in killing off the micro-organisms which cause disease. So beside the stimulating effect which sunlight has upon the human body it has a great bactericidal value. Hence, the doctrine of fresh air and sunshine is eminently correct. And sunshine through a window is not nearly so beneficial as direct sunlight, as these ultra-violet rays have great difficulty in passing through glass. This is very well illustrated by photographs taken by Prof. R. W. Woods of Johns Hopkins University. In one case a photograph is taken of a doorway with part of the light passing through the glass door and the rest of the light through the unobstructed doorway. In ordinary sunlight the glass door appears perfectly transparent, but when the same view was taken by ultra-violet rays alone, the glass in the door totally obstructed the rays.

Medical applications of this principle have been made in the use of ultra-violet rays and X-rays for the treatment of certain diseases. The general effect of ultra-violet rays, radium emanations and X-rays is quite similar except that these last rays are far more powerful in their chemical and penetrative effect, and are in general far too powerful for continuous application.

In 1896 Finsen, a Danish physician, opened his famous light institute in Denmark for the treatment of skin diseases by the application of germicidal ultra-violet rays. He used as a source of ultra-violet rays, an arc lamp of high power. This lamp was inclosed in a cylindrical casing which served somewhat as a reflector. At the bottom end of the cylinder were arranged four tubes which served to direct the rays upon the patient to be treated. Quartz lenses were used to gather and transmit the ultra-violet rays. These tubes were filled with clear water to cool the tubes and to cut out heat rays. Water is quite transparent to ultra-violet rays, but absorbs heat rays readily. The patient is placed so that one or more of these tubes can be directed upon the diseased parts and the lower end of the tube containing the quartz crystal is then pressed upon the skin of the patient.

The ultra-violet rays have not very great penetrative power, and hence, are suitable for treating only skin diseases and superficial infections. But this is advantageous as the underlying tissues are not inflamed. The cases which Finsen treated were mostly cases of lupus. This is a tubercular infection of the skin which acts much like cancer. The skin becomes rough, inflamed and slowly rots away, leaving small tubercule or wart-like projections about the edges of the sore. Another disease readily cured by ultra-violet rays is psoriasis, in which the skin becomes scaly and covered with white flakes and which causes intense irritation and itching. Finsen's followers even claim to cure cancer, but this is extremely doubtful, and no authentic proof has been submitted. The application of ultra-violet rays was made in treatments lasting about an hour. It was found that too long continued application inflamed the skin just as exposure to the light of the sun. In effect the inflammation is nothing more than ordinary sunburn.

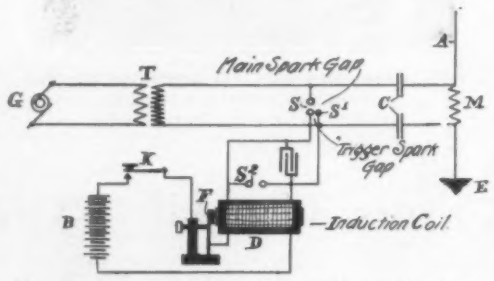
In cases of long standing disease it was often necessary to use silver nitrate as a caustic to clean the spot to be treated by the ultra-violet ray. The X-rays were also very useful in cases of deep seated disease as they have so much greater penetration effect than the ultra-violet rays.

This form of treatment was found to be very effective and over 2,000 cases have been treated, of which over 60 per cent were cured. This extensive treatment was made possible by State contributions. At first, cases of very long standing and of people of very advanced age, crowded the institutes and the cure of these was extremely doubtful.

By far the most important use of the ultra-violet rays at present is the use of the light for purposes of sterilizing drinking water. This has reached a high stage of development in France. As early as 1906 Messrs. Courmont and Nogier began experiments to determine the value of ultra-violet rays in sterilizing liquids by their action. As a stimulus to their activities the city of Marseilles in 1909 authorized an open competitive test of water filters and sterilizers for purifying the city water supply, which was notoriously bad.

The competitors were to install and operate at their own expense a purifying plant capable of furnishing 200 cubic meters = 52,840 gallons of water in twenty-four hours. The apparatus finally adopted was an installation using a rough filter and a sterilizer of the type shown in the accompanying drawing, using a Westinghouse-Cooper-Hewitt mercury vapor lamp with quartz tube. The water is run through a cast iron box in the top of which is suspended a quartz mercury arc lamp. The lamp is inclosed in a box with quartz sides. This box keeps the water from striking against the side of the lamp. Baffles are arranged in the box to cause the water to circulate repeatedly with the range of influence of the rays. The water must first be filtered to make it clear and transparent, as cloudy water shuts off the rays.

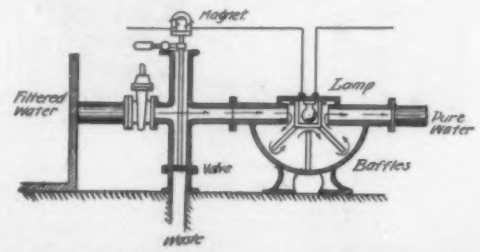
The box lamp is pivotally mounted so as to allow tilting of the tube to start the light. In series relation with the lamp is arranged an electromagnetic control of the waste valve as indicated in the drawing. In case the current fails or the lamp goes out, the valve automatically opens and prevents any of the water passing through the apparatus without being sterilized. This is highly important for even a very small amount of unsterilized water passing into the pure water mains would contaminate the entire supply for some time. With this apparatus it is possible to sterilize 600 cubic meters (158,520 gallons) in twenty-four hours at a cost of about $10 a million gallons. The water is not altered chemically and the taste and odor is not changed in the least. The importance of this application can hardly be overestimated. In the case of city water supply it is apparent that where this form of apparatus



The principle of De Forest's wireless system based on Hertz's discovery that ultra-violet rays striking a metal plate ionize the air about it.

is used there is no risk of a wholesale epidemic of typhoid and other fevers. In use for hospitals, hotels, barracks, and school buildings this means of sterilization is unsurpassed. In commercial installation, where pure water supply is important, such as breweries, canneries, creameries and prepared food laboratories it is very advantageous.

Regarding the effect of the rays upon bacteria the action has been supposed to be due to formation of ozone, which would then act upon the bacteria, but on the contrary the bactericidal action is direct. No ozone is formed in the water though the incidence of ultra-violet rays upon the atmosphere causes the formation of ozone. The water thus treated was first tested by feeding to dogs and guinea pigs, but no bad effects were produced, and since then, practical use for domestic purposes has proved the water absolutely harmless. A peculiar fact noted, is, that pathogenic or disease causing germs are killed much more quickly than are the ordinary harmless germs. Germs that resist boiling



Courmont-Nogier apparatus for use in sterilizing water by means of ultra-violet rays.

for a long time are killed instantly when exposed directly to the influence of the rays. This scheme has been applied as well to sterilizing milk, beer and other liquids, but the apparatus is modified so that a thinner stream is exposed to the rays. All colloidal and suspended matter cuts off the rays very quickly. The passage of the ultra-violet rays through air ionizes the latter and forms ozone, which gives the milk a bad taste, so that it is necessary to pass a current of nitrogen across the surface of the liquid to shut off the oxygen. This increases the cost above that for sterilized water, but it is trifling.

However, practical application of this effect is made in the bleaching of flour. After milling, the flour is slowly sprinkled down a chute. In this chute is an arc lamp of high power. The ozone generated by the ultra-violet rays from this lamp bleaches the flour to perfect whiteness. The cost of such treatment is insignificant, and by this means flour made of a poor grade of wheat appears as white as that made from the highest grade. The flour is not altered in nutritive value when so treated, but the use is deceptive, as the poor quality cannot be distinguished and is sold for the same price as the higher grades.

Another application of the same principle has been made in the ageing of liquors. These are exposed to the incidence of ultra-violet rays, and in a few weeks the so-called "ageing" which normally requires years, is accomplished. In the treatment of whiskies and liquors of high percentage of alcohol, the effect seems to be upon the fusel oil and higher alcohols, breaking them up into lower forms, thus rendering them harmless and greatly improving the flavor of the liquor.

Many of the effects of ultra-violet rays are not fully understood as the application and use is of such recent date, but as early as 1887 Hertz, the great physicist, noticed that the ultra-violet rays striking upon a clean metallic plate tend to give it a positive charge and ionize the air about it. De Forest has made use of this fact in a very ingenious scheme for wireless telegraphing, the circuit for which is shown herewith. A small auxiliary spark gap called the "trigger spark" gap is placed near the main spark gap. The main spark gap is made so great that ordinarily the current from the transformer cannot pass, but as soon as the "trigger spark" from the small induction coil jumps the small gap, the air in the larger gap is ionized and the main current readily passes. But as soon as the "trigger spark" ceases the main spark also ceases. This enables very heavy currents such as are used for signalling great distances to be used without expensive and troublesome relays and contacts which very quickly burn up, due to the arc caused by making and breaking a heavy high voltage current.

One of the most bold and startling applications of the use of ultra-violet rays has been made in a study of minerals, more particularly in determining the elements upon moon, sun and stars. The method pursued is somewhat as follows: A photograph of the moon is taken by ordinary yellow sunlight reflected from the moon's surface, and certain dark spots and other light spots are noted on the surface. Then a photograph is taken by ultra-violet rays alone by means of a quartz lens coated on one side by a thin film of silver screening out all other rays. The contrast is remarkable. Some of those dark spots appear bright and some appear even darker than by yellow sunlight, while some of the bright spots appear totally dark. This is due to the fact that most substances absorb the ultra-violet rays to a greater or less degree than they do yellow light. By suitable comparison with known substance on the earth it is possible to arrive at the minerals that make up the surface of the moon. This idea is in practical use at the Harvard observatory.

Another use of ultra-violet rays that promises greatly to surpass any of the present uses is the manufacture of chemical substances and compounds. First, is the synthetic composition of rubber. Organic compounds that have hitherto resisted treatment except by a very tedious and expensive process under the influence of these rays, readily assume the desired form and make the commercial manufacture of rubber possible. However, this is so recent as to be largely in the experimental stage, but on July 16th, 1912, a patent was granted to German inventors, Messrs. Graul and Hanschke, for such a process.

Another use to which these rays is put is the manufacture of sulphuric acid (H_2SO_4). Under the influence of the ultra-violet rays the sulphur dioxide (SO_2) takes on an additional atom of oxygen and becomes sulphuric anhydrid (SO_3), which in combination with water, forms the acid. This supplants the use of the expensive platinum black, and gives a pure process.

Many other uses not as yet of commercial importance are being developed. But the great value of this form can be readily seen from the above. It takes photographs, gives summer tan, bleaches flour, ripens vegetables, sends wireless telegrams, makes the manufacture of rubber heels and automobile tires possible, purifies drinking water, sterilizes milk, and ages whisky.

Before a recent congress of German naturalists and physicians, Dr. W. Stempell described the utilization of ultra-violet rays in studying micro-organisms. By the aid of ultra-violet rays it is possible to discover objects which cannot be seen in an ordinary microscope because of their extreme smallness. With the aid of ultra-violet rays Dr. Stempell discovered the spore of the dreaded parasite that infests the silkworm—a feat which would have been utterly impossible with ordinary light. Dr. Stempel suggests that it may thus be possible to discover the microbes of infectious diseases of whose bacteriological origin little is known. The accompanying illustrations, Figs. 1 to 5, show microphotographs of the spores of *Nosema bombycis* taken by means of ultra-violet rays. Fig. 1 is a spore lying somewhat obliquely, to the plane of the microscope slide (magnification 3,600:1). Figs. 2 to 5, a number of spores of which three contain similarly directed spirals. The illumination is oblique, with rays directed parallel to the long axis of the three spores.

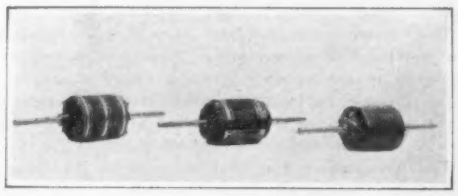
Invention Contest First Prize Article

What Are the Ten Greatest Inventions of Our Time?

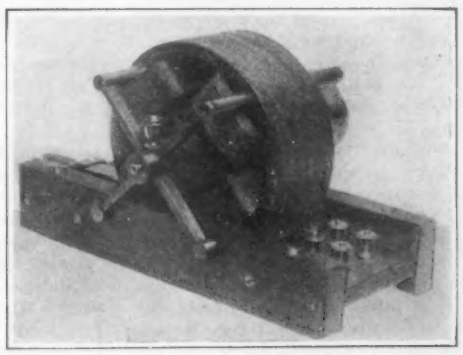
By "Esam" (William I. Wyman, Washington, D. C.)

"Five-and-twenty years ago is a hundred years off—so much has our social life changed in those five lusters."—*Thackeray in "The Newcomes."*

NO single invention of the last twenty-five years initiated an industrial epoch in the sense that the locomotive or Bessemer converter did, yet no former period has been so rich in developments of striking importance or so productive of improvements whose aggregate so vitally affected our economic and social



Three rotors used with the early Tesla induction motor shown below.



One of the earliest of Tesla's induction motors.

Although it weighed only a little over 20 pounds, it developed ¼ horse-power at a speed of 1,800 revolutions, a performance considered remarkable at the time.

life. In this short space of time the dreams of ages have come true—man has been able to fly, opaque bodies rendered transparent, and intelligence transmitted between distant points without material communicating means.

This short quarter century has seen the world-wide acceptance of electrical transportation, the introduction of high-power generation and transmission of electricity, the radical changes in construction due to the use of steel and re-enforced concrete, and innumerable valuable improvements in chemical and allied arts. Perfected during this period were such epoch-making inventions as smokeless powder, high-speed steel, contact method of making sulphuric acid, electrolytic refining of copper, the quick-acting brake, automatic telephone exchange, centrifugal cream-separator, tungsten lamp, Diesel oil-motor, and Harveyized armor-plate, which changed existing practices so radically or induced economies of such vast degree as to make it difficult to exclude them from any list except by the adoption of a standard so high as to be unthought of at any other time.

In making a selection from the bewilderingly opulent array of creative activities of the period, only such inventions were included as were most revolutionary in character in the broadest fields, which affected most our mode of living, or which opened up the largest new sources of wealth. So weighing the merits of the different inventions, it is concluded that the ten greatest and their approximate date of successful commercial introduction are: (1) Electric furnace, 1889; (2) steam turbine, 1894; (3) gasoline automobile, 1890; (4) moving pictures, 1893; (5) wireless telegraphy, 1900; (6) aeroplane, 1906; (7) cyanide process, 1890; (8) linotype machine, 1890; (9) induction motor, 1890; (10) electric welding, 1889.

The date of commercial introduction is held to be that from which orderly and continuous development proceeded. No invention was considered eligible which could not provide subject matter for a patent controlling its practical operation for at least a part of the period. Such a rule excludes re-enforced concrete, the basic ideas of which had been established in construction before 1870, although not extensively practised until ten years ago, while it permits of the inclusion of the electric furnace, the broad principles of which had been known thirty-five years ago.

As soon as the last essay for the SCIENTIFIC AMERICAN'S *prize contest on the subject "What Are the Ten Greatest Inventions of Our Time, and Why?" was received, the Editors cast about for judges who, in accordance with the rules, were to consider the contributions. They were fortunate in securing Prof. H. deB. Parsons and Dr. Gustav Lindenthal, men of wide culture and engineers of vast experience. Their decision is rendered in the following letter:*

New York, 17 October, 1913.

To the Editors of the SCIENTIFIC AMERICAN,
361 Broadway, New York city.

Gentlemen: Complying with your request to select from the papers submitted for the Prize Article Contest mentioned in the SCIENTIFIC AMERICAN, 30th August, 1913, we beg leave to report to you the following as our decision:

We do not consider that any of the papers submitted fully complied with the spirit and conditions of the invitation. Realizing that a strict interpretation was not intended on your part, we have made our selection, and award as below:

First prize ($150)—Paper marked "Esam."
Second prize ($100)—Paper marked "Altair."
Third prize ($50)—Paper marked "Cherry Valley."

We also consider the following papers as worthy of honorable mention, viz.: "Idline," "Kennebec," "Nicolas," "Spero," "Theta," and "X. P."

H. DEB. PARSONS,
22 William Street, New York.
DR. GUSTAV LINDENTHAL,
68 William Street, New York.

The essay of "Esam" (Mr. William I. Wyman), which won the first prize of $150, is published herewith. The essay of "Altair" (Mr. George M. Dowe, the United States Patent Office), which won the second prize of $100, will be published in next week's SCIENTIFIC AMERICAN. *The essay of "Cherry Valley" (Mr. W. C. Cahall), who won the third prize of $50, will be published in the* SCIENTIFIC AMERICAN SUPPLEMENT *of November 15th, and may be followed in that publication at weekly intervals by the essays of "Idline" (Emil Schultze, Baltimore, Md.); "Kennebec" (Louis P. Webert, Bath, Maine); and "Nicolas" (Emil Stoop, St. Nicolaas, Waas, Belgium), all of whom received honorable mention. The essays of "Spero" (Dr. Thomas Agius, Floriana, Malta); "Theta" (George S. Clements, London, England); and "X. P." (G. Rex Frye, Washington, D. C.) may likewise be published in the* SCIENTIFIC AMERICAN SUPPLEMENT *provided the exigencies of space will permit.*—EDITORS *of the* SCIENTIFIC AMERICAN.

The Marconi wireless station on board the "Olympic."
No important passenger ship is now without wireless apparatus.

The newest model of the Mergenthaler linotype.

An automatic machine which must rank with the invention of movable type and of the printing press in spreading knowledge.

What the Electric Furnace Has Accomplished.

The electric furnace, through the generation of a heat so intense as to simulate some of the primal forces of nature, has produced for the first time many absolutely or commercially new products. It can make artificial diamonds and other gems; it is the only means for commercially producing carborundum (the hardest of all manufactured substances), calcium carbide (the source of a valuable illuminant and a nitrogenous fertilizer), and artificial graphite, which is finding extended use in the arts; and it has converted aluminium from a merely precious to very useful metal and reduced its price from more than $12 a pound to less than 25 cents. It is responsible for all methods of fixing nitrogen, which, in view of the approaching exhaustion of the natural supply of Chili nitrate, obviates a possible nitrogen famine, and alone makes this agency of inestimable service to mankind.

The electric furnace is radically transforming the steel industry. It produces steel of crucible quality with almost open hearth economy, and for the first time since 1740 the expensive and intricate crucible process finds a competitor. In providing rails and heavy-service steel of crucible characteristics in texture and toughness at slight increase of cost over the comparatively impure and unreliable

older products a revolution of astounding proportions is going on before our very eyes. The Cowles brothers, Hall and Acheson, in America, Heroult and Moissan in France, Borchers in Germany, and the Norwegian Birkeland, are the most notable figures in this development.

Wilbur Wright.

Steam Turbine.—A New Heat Engine.

The greatest agency in the service of man is the steam engine. No other device has been so studied, improved and super-refined. But its usefulness reached its limits when it failed to satisfy the enormous greed for power demanded in electrical generation and ship propulsion. The steam turbine solved the problem, and the reciprocating engine, which has borne the brunt of the world's work so well during its century's primacy, has all but been eliminated in these two vast fields.

The turbine has effected striking economies in steam consumption, attendance and installation. It has abolished pounding and vibration, eliminated cumbersome and expensive foundations, reduced the space occupied from one to two thirds, and made it advisable to send efficient but older type of equipment to the scrap heap.

Six million horse-power were employed in turbine-driven ships in 1910, and a like amount is used in turbo-generators in this country alone. The days of the reciprocating engine are almost numbered—the electric motor is driving it out of the factory and the generation of electricity requires turbine installation.

Such is the vast extent of the revolution now being effected in our basic engineering art by the steam turbine, invented by Parsons in 1884, but not recognized as a commercially practical proposition until ten years later.

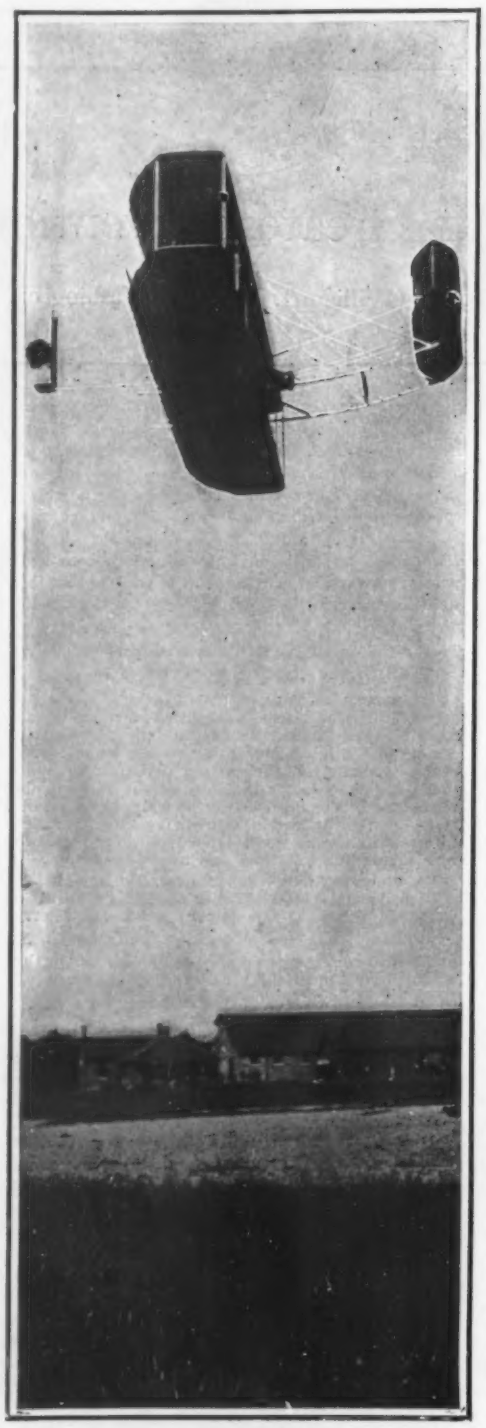
The Gasoline Automobile and the Change Which It Has Wrought in Transportation.

The inventions of this period which have worked the most rapid alterations in the more intimate affairs of life are the gasoline automobile and the moving picture. The "auto" in this short space of time has developed from a mere experiment to the making of one of our largest industries, has caused the creation of thousands of miles of improved highways, has almost abolished the horse in the cities, has changed to a marked extent the manner of living of an appreciable portion of our people, and has directly induced extensive and radical improvements in and created dozens of collateral arts.

Superficially, the "auto" appears to be the sum of a series of engineering developments in which great inspirational achievements were wanting. But no fact is plainer than that its introduction was neither casual nor fortuitous—the whole history of a century's insistent but unsuccessful endeavor to provide a practical self-propelled car proves that the success of any type that once answered requirements would be immediate. Such success did come with the advent of the Daimler motor, and not before. The distinctive features of this motor were lightness and speed, but these were precisely the factors that differentiated it from its predecessors and that *peculiarly adapted this engine for its specially designed purpose.* As one authority says, "The improved engine in 1889 by Daimler was that which really set going the motor-car movement." In that year, Panhard and Levassor, Frenchmen, acquired Daimler's patent rights, devised the first motor carriage along present lines, and may be said to be the creators of the automobile industry. In this country, the automobile is making industrial history; the annual output is reaching toward a half billion dollars, the "auto" manufacturing centers are growing faster than the increasing population can be housed, and the value of its production has increased more than fiftyfold in the last census decade.

The Moving Pictures.—How a New Art Was Created.

The moving picture has transformed the amusements of the multitude and promises a future so enormous that only its present swift development can give faintest indication of. Offering the first serious check the theater's popularity has suffered since Shakespeare's time, its ramifications are becoming more varied and extended. As a factor in education, science, trade, and in recording current history, it has seen its beginning only, and in its application to amusement in its higher form we already have a promise of a large and brilliant future.



Orville Wright flying at Fort Myer in 1908 and complying with the army requirements.

Orville Wright.

Thousands of theaters are devoted to the "movies" in this country, in which eighty million dollars are invested, producing an annual revenue fast approaching three hundred million dollars. The whole world is levied upon to "stage" the play, history and travel visualized, and the obscure processes of nature explained and analyzed.

The "kinetoscope" of Edison "was the first commercial appliance to show pictures in natural movement," although he owed much to the Eastman film and prior investigations. As with the automobile and aeroplane, great credit must be given to French promoters for first showing its possibilities on a marked scale.

The Aeroplane.—The Realization of an Age-long Dream.

Next to the philosopher's stone and perpetual motion has man's attempt to fly been the object of most persistent pursuit. No other problem in the realm of invention has caused such heart-breaking discouragements or called for such sacrifice of life. In spite of authority, however, the quest for the flying machine was not chimerical, although it seems but yesterday since success capped the efforts of the Wright brothers.

Although the aeroplane is radically transforming military tactics and as an engine of war cannot be ignored, it presents the least commercial utility of all the inventions considered. But because it is in many respects the most radical innovation in the whole history of locomotion and because the *perfection* of this device opens up possibilities dazzling to contemplate, present utility must be ignored in appraising this striking accomplishment. It is only necessary to imagine a condition where frontiers are eliminated, valuable rights of way unessential, and fortresses and battleships impotent, to realize the overwhelming revolution which will come with the perfecting of air navigation—an outcome by no means beyond the limits of possibility.

Wireless Telegraphy, the New Means of Communication.

If the aeroplane is the most spectacular achievement of this age, wireless telegraphy appeals most to our imagination and dramatic sense. Its importance and significance however are in direct proportion to the hold it has on our interest. The scheme of transmitting intelligence was never complete so long as ships at sea and remotely situated stations could not be communicated with. "Wireless" supplied this "missing link" and made intercommunication as universal as the world is wide. In the short fifteen years since its introduction by Marconi, wireless apparatus has become part of the equipment of every modern sea-going and naval vessel, has been placed in hundreds of Government establishments and dozens of relatively inaccessible stations, has become an important factor in military and naval operations, and, most important of all, has robbed the sea of its terrors and saved thousands of lives through its operation. Rapid as has been its growth, it is but in the infancy of its development and usefulness and promises a career in overland and inter-continental communication quite as

Thomas A. Edison, the most brilliant of American inventors, and the man to whom the entire moving picture industry pays tribute.

startling as its performances at sea.

The Cyanide Process and Why it is a Great Invention of Our Time.

The cyanide process has been one of the main agencies whereby the world's production of gold was trebled between 1890 and 1908. Patented in 1888 by MacArthur and Forrest, it was first introduced on a large scale at Johannesburg in 1890, and is now universally established. The process has revolutionized the art of the metallurgy of the precious metals, but its indirect economic and social influence has been incomparably greater than its direct result in increasing wealth, wide and deep as has been its application in other directions than gold extraction. Gold is the life blood of trade, and whether or not one believes its increased production is the cause of the high cost of living, there can be no question of the profound effect the quantity of gold in circulation has upon commerce and the economic structure, and consequently of the vast significance of the invention to which such increased productivity is due largely.

The Induction Motor of Nikola Tesla and How it Revolutionized Power Transmission.

Ninety per cent of electric current generated is alternating because larger generating units can be utilized and the current more easily transmitted. The induction motor, constructed by Tesla in 1888, and independently suggested in principle by Ferrari, was the first satisfactory medium to transform this current into power.

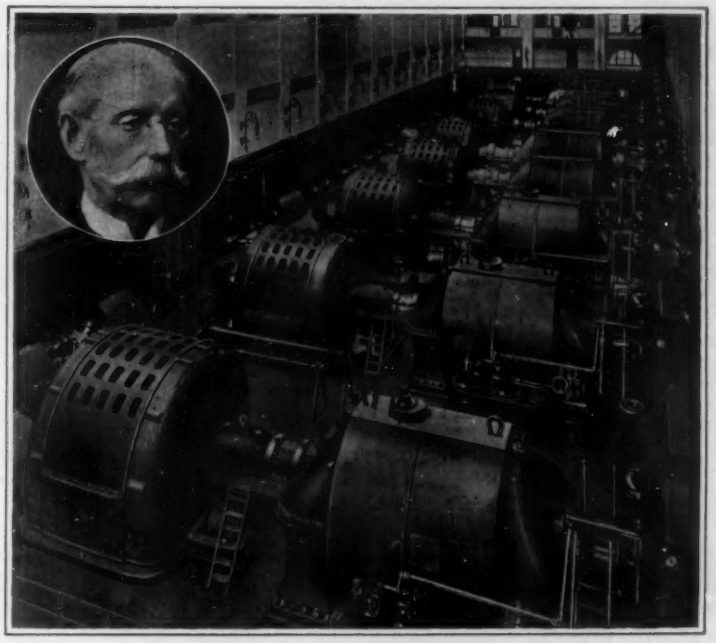
This epoch-making invention is mainly responsible for the present large and increasing use of electricity in the industries. It is working a revolution for economy and comfort in the mill, factory and workshop. In making the motor an individual power unit, it has made power arrangement elastic, drawing upon energy only when needed and applying it directly only where wanted, and has abolished line shafting and belting. It conserves thirty to sixty per cent of the energy formerly wasted in uselessly whirling line shafting. It saves overhead space and increases productivity by making the shop lighter, safer, cleaner and less noisy. And so well recognized are these advantages that establishments in every big industry are installing these motors as a measure of economic self-defense.

The Linotype and the Spread of Knowledge.

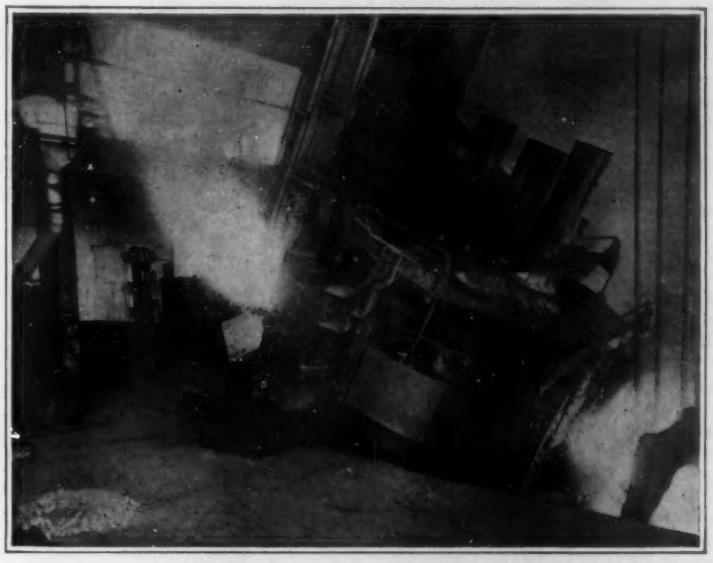
The "art preservative of all arts," in the department of composition, remained the same in all its fundamental particulars for four centuries after Gutenburg first set movable blocks to form a printing surface. The most intricate devices ever evolved and the most ingenious efforts ever expended, failed to successfully supersede hand composition until Mergenthaler's linotype established its feasibility about 1890 and entirely overcame public skepticism and inertia a few years later. It is enough to say that an operator can set from five to ten times faster than the average hand compositor, that the type composed always presents a brand new face, that the cost of foundry type and auxiliary paraphernalia is dispensed with, and that distribution of the type matter is abolished, to recognize the breadth and thoroughly revolutionary character of this invention, and to appreciate why every newspaper and large printing plant in the world has installed machine composition.

The Electric Welding Process of Elihu Thomson.

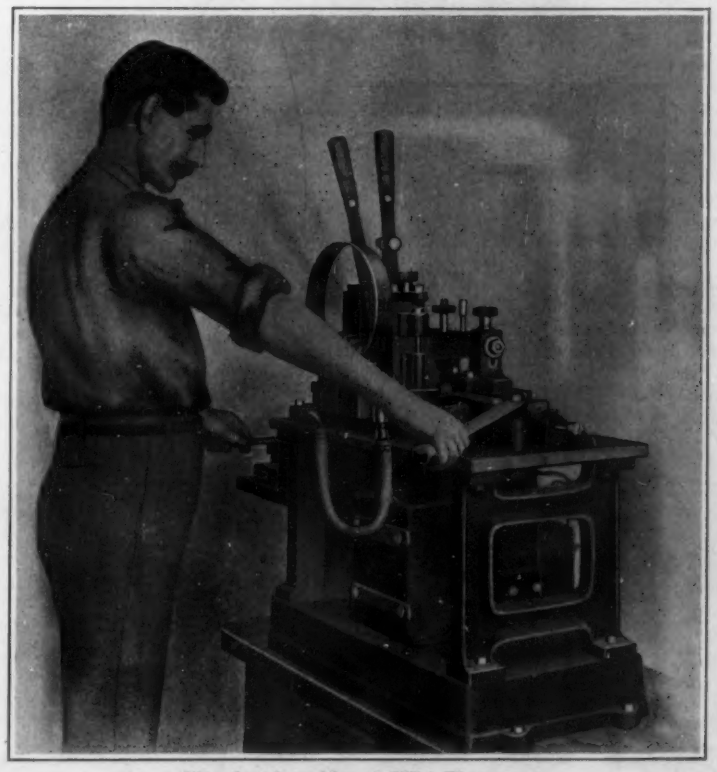
Electric welding in the form in which the art first received commercial recognition is the invention of Elihu Thomson. The art of the smithy, whose annals fade back into prehistoric times, underwent its first radical change in its entire history with the introduction of this invention about a quarter century ago. It has not only transformed one of the oldest of the arts, but is performing what has never before been thought possible in this art. This device not only joins previously considered "unweldable" metals, like brass, bronze, cast iron, etc., but different and weldably antagonistic metals can be united in a solid union. Shapes so intricate as to be beyond the capacity of welding by any previous device or process, or which could only be joined by riveting, are readily united by the electric welder. The applicability of the process to practically all metals, the dispensing of heavy pressures, the surety and swiftness of the results, and the economy and cleanliness of its working, made it a startling successful proposition from the very first, and now its application is as broad as the metal-working industry itself.



A typical central station in which Parsons turbines are used to drive electric generators. The portrait is that of the Hon. C. A. Parsons.



The electric furnace is radically transforming the steel industry.



The electric welder of Elihu Thomson.

The machine here shown will weld two hundred steel bands in an hour. It takes only a few seconds to make an electric weld. A heavy current of electricity at a low voltage is passed through the abutting ends of the metal pieces to be welded, thereby generating heat locally at the points of contact, while at the same time pressure is applied to force the parts together.

The inventions of most far-reaching effect have been achieved mainly in the few departments of power, communication and production. Modern civilization received its impetus from the inventions of the steam engine, locomotive and telegraph, and the Bessemer converter, typifying these three departments. Of the inventions selected it will be observed that seven fall within these activities. Of the remainder, it is sufficient to say that for the first time we have means to visually transcribe animated life, and have seen hand methods in two ancient arts superseded by machine operation.

Of all the great achievements of this period, these ten have been chosen because they are pioneers of the highest order and have been most revolutionary in the most potent fields of service to mankind.

The Ten Greatest Inventions

WHEN, a few months ago, the SCIENTIFIC AMERICAN offered prizes for the three best essays on the ten greatest patentable inventions of the past twenty-five years, we had no idea that the question would be a very difficult one to answer. It seemed certain that ten inventions could be chosen which would stand out prominently above others and which would hold their pre-eminent position with convincing argument. In response to our offer essays came in from all parts of the United States, and from abroad as well. Among the essays receiving honorable mention, as published on another page, will be found one from England, one from Belgium and one from Malta. It is interesting to note also that several of the essays came from women, showing remarkable interest in invention among the gentler sex.

When the essays were opened, the lists showed a surprising diversity of opinion. No two competitors selected the same set of inventions. In fact, only one invention, that of Wireless Telegraphy, was conceded unanimously to belong among the ten greatest. The vote on Aeroplanes was almost unanimous. But beyond that there was not the slightest trace of unanimity. This result was, to us, surprising indeed. In the conditions of the contest we had stated that greatness would be measured in terms of practical success and general usefulness to mankind; we limited the contestants to machines, devices, and discoveries commercially introduced in the last twenty-five years, and laid special emphasis on the fact that the inventions must be patentable, although not necessarily patented, stating also that the patent might antedate the twenty-five year period provided the commercial introduction of the invention took place within the specified time. With these simple conditions governing the contest, it seemed strange that the contestants could agree on only one invention. But when the matter was put to a vote among the Editors of the SCIENTIFIC AMERICAN, we ourselves could not agree on more than half a dozen. Arguments a-plenty, and good ones too, could be put up in behalf of a score or more of inventions. The matter proved so interesting that we called for a general vote from our readers on the subject. A dozen essays were picked out at random, and these were found to contain forty different subjects.

The list of these subjects was published with our call for votes, merely to show the disagreement on the question. This

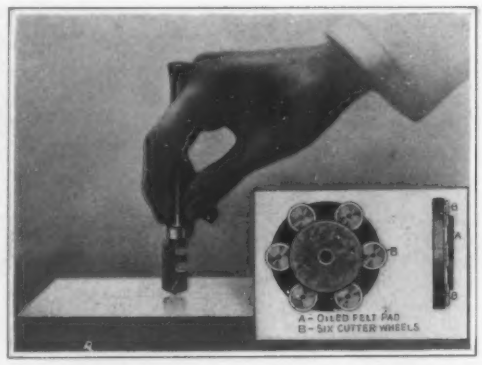
(Concluded on page 350.)

A Multiple Disk Glass Cutter

FOR more than four thousand years there was no other means of cutting glass than with the diamond, and it was usually done with the chip diamond. It was, however, very effective, but it remained for an American to invent the little wheel or disk approaching the hardness of the diamond and taking its place for doing this work.

Among the several types of wheel glass cutters manufactured, one of the most unique is a multiple disk cutter with a turret head containing six wheels. These small wheels or cutters are placed around the periphery of a larger disk which is pivoted on one side of the holder. One wheel after the other may be brought into the position for cutting by simply turning the turret head by loosening and tightening a screw.

In order to prevent the cutting edges of the disk from becoming rusty, a disk of absorbent material is placed on one side of the turret head in such a manner that it continually rubs against the upper edge of the disk which is in the cutting position. This absorbent material is filled with oil which keeps the wheels clean and free from rust.



Multiple disk glass cutter. The insert shows the turret head and its wheels in two positions.

Lessons of the Disaster of the "L. II."

By Carl Dienstbach

THE most advanced of all dirigibles, the giant Zeppelin "L. II.," completed for the German navy, has shared the fate of one of the crudest early attempts at airship construction—Severo's "Pax." In other words, the "L. II." exploded and burnt in the air and everybody on board was killed. One man, in spite of terrible burns, survived the fall (of 900 feet) for several hours.

No general conclusions can be drawn from this latest and most terrible disaster sustained by a gas-inflated ship. Nor is the conclusion justified that gasless aeroplanes are safer. If a comparison is made between dirigible and flying machine on the basis of safety, every hour spent in an inflated dirigible must be counted against only the actual flying time of aeroplanes. On that basis the comparison will be in favor of the dirigible. Aeronauts are not afraid to ascend in a spherical balloon filled with inflammable gas. Statistics covering a century and a quarter have shown how slight is the danger of explosion if reasonable precautions are taken. When Severo's airship caught fire, a commission of French engineers decided that it was due to confined spaces within the structure, where a stagnant mixture of air and gas might collect like so much gunpowder. That explosive mixture, once ignited, is worse than so much dynamite. To the ignition of such a mixture the accidents to the old Severo and the latest Zeppelin are due. Gas alone is as harmless as so much flour. An official rule was laid down at the time of the Severo inquiry that no design with such confined spaces should be tolerated. This rule was easily observed by the old, slow "full rigged" ships, with the car hanging far below, and a goodly draft of air automatically sweeping the intervening space.

Curiously enough, it seems to have been progress in attaining staunchness and speed, that eventually brought about a design that embodied the very defect that caused the destruction of Severo's dirigible and made it possible for an explosive mixture to accumulate in enormous quantities.

Close proximity of motors and gas bags is highly desirable and even necessary in a very fast and strong dirigible. However flimsy the fabric may seem, it is just as efficient in keeping the gas out of harm's way as the plates of a gasometer. The fabric of a Zeppelin cannot be torn unless the frame and the netting which strengthen it break first. It cannot retain the gas indefinitely. Still, so little filters through, that a candle can be burned three inches from an inflated balloon, as long as the gas remains at constant temperature and pressure. Gas never becomes dangerous unless it expands from heat or lowered air pressure, and, overflowing the balloon through the safety valve, is not instantly diluted with enough air to make the mixture non-combustible.

Confined spaces within the structure of an airship are harmless as long as they are swept by a blast strong enough sufficiently to dilute any amount of gas which may there collect.

The "L. II." had literally a tunnel running within the hull. Within that tunnel gas leaking from the balloons in many compartments could accumulate and mingle with air. She should have had a blower to drive out the hydrogen that had leaked out, or at least to dilute it with an enormous quantity of air. Indeed, she needed a blower as badly as a coal mine. "Gas" might be expected every time the ship rose or was exposed to the sun.

A blower would not detract much power from propulsion, because it is not needed while the ship is under full headway. The ordinary ventilators of a steamer become very efficient when they are applied to a speeding dirigible, because the latter gets the wind strongly always from the same quarter—dead ahead. While the airship is at rest, the motors, instead of running empty, should drive a safety-fan. Any confined spaces must in addition be sealed against overflowing gas, simply by providing each gas valve with a short gas-tight funnel, through which the gas is carried outside of the hull, into a diluting airblast which must be furnished by blowers while the ship is at rest.

There seems no doubt that in designing and building the "L. II." "internal safety" was overlooked and attention concentrated on strength of construction, so that storms could be weathered.

A mine rescue telephone equipment. The transmitter is strapped against the throat so that the rescuer talks, not with his mouth, but with his neck.

A Mine Rescue Telephone Equipment

THE development of practical telephone equipment for mine rescue work to supplement the oxygen apparatus now in almost universal use marks a great step forward in providing ways and means for preventing the great loss of life which, in years past, followed every mine disaster. The great value of the oxygen helmet, which permits its wearer to enter a mine and remain in the presence of smoke and poisonous gases for hours at a time without danger of being overcome, has been evidenced by the hundreds of lives which have been saved through its agency. The iron box mine telephone has also proven to be of inestimable service in protecting lives and property. In fact, the laws of a number of States in which mining operations are conducted, include statutes making compulsory the use of telephones underground.

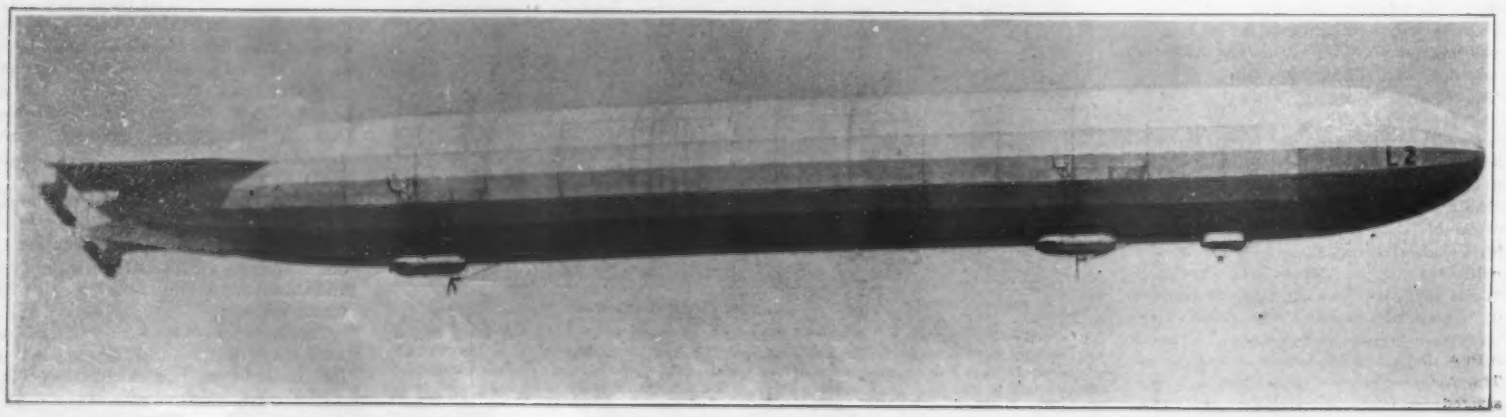
There has been lacking, however, until very recently, a means for keeping the advance or rescue party in the mine in constant communication with the rear party at the entrance of the mine. The need of this was advanced by the United States Government Bureau of Mines, as well as some of the large mining interests. As a result it is now possible to obtain a light serviceable and simple telephone equipment which will meet all the requirements of this unusually severe class of service.

One of the first difficulties encountered in the development of the telephone equipment for the helmet man was to devise a transmitter which would not interfere with breathing. With the oxygen helmets and other types of breathing apparatus in use for rescue work, the mouth is covered in such a way as to prevent its use for talking. This led to the design of a transmitter which is fastened to the throat by means of a pigskin harness and transmits speech on the principle that the vibrations of the vocal cords are transmitted through the throat walls and will in turn act upon the diaphragm of the transmitter. It is essential that the transmitter be held firmly against the skin, and for this purpose a soft rubber cup, which will conform to the curves of the throat, is provided where the mouthpiece would ordinarily be placed. It has been found by laboratory tests and tests made at the Bureau of Mines in Pittsburgh that the throat transmitter will transmit speech practically as well as the ordinary telephone.

Attached to the same harness with the transmitter is a water-case receiver equipped with a leather head band to clamp it firmly to the ear. The head harness, with its receiver and transmitter, is so constructed that it will not interfere with the operation of any of the various types of oxygen apparatus on the market. The head equipment, furthermore, is extremely light and does not in any way inconvenience its wearer.

The telephone apparatus used by the directing party at the outside of the mine is a standard switchboard set consisting of a chest type transmitter and head band receiver.

A "Safety-First" Lesson.—In a recent publication by the Pennsylvania Railroad, whose object is to promote "safety-first" principles among its employees, we note two illustrations, each showing a man seated on the wooden shield covering a third rail, and engaged in some repairs or inspection of a freight car. In the first view, entitled "The Wrong Way," the man is seated directly upon the third rail structure. In the second illustration a large rubber blanket has been thrown over the rail to protect the man's body or his tools from causing a short circuit.



The Zeppelin airship "L. II.," which exploded and burned in mid-air, killing twenty-eight men.

The Heavens in November

Three Interesting Comets Now in the Evening Sky

By Henry Norris Russell, Ph.D.

COMETS continue to be the principal objects of interest this month—even more so than last, for three at once are visible (with the telescope) in our evening skies, and two of these are of unusual interest.

Metcalf's comet, of which we spoke last month, has been a conspicuous telescopic object throughout October, passing right across the circumpolar sky. It is now receding from us and from the Sun, and rapidly growing fainter, but is still visible in a small telescope.

According to an ephemeris computed by Prof. Crawford and Miss Levy at the University of California, the position of this comet should be as follows:

	R. A.	Declination.
November 1....	20 hours 46.4 minutes	+ 2° 18′
November 15....	20 hours 46.9 minutes	— 8° 32′
November 30....	20 hours 52.9 minutes	—14° 26′

The brightness diminishing from 1.3 times that at discovery at the beginning of the month to 0.3 at its end, so that by that time it will be a pretty faint object. The comet's orbit, according to the best data so far published, seems to be nearly, if not quite parabolic, and hence it must be very long since it last visited the sun.

Neujmin's comet is theoretically a much more remarkable object, but is unfortunately too faint to be observable with small telescopes. There is no doubt now that its orbit is elliptic, and its period fairly short, the preliminary computations of various astronomers giving periods of from nine to twenty-five years. It will not be possible to determine the exact period until observations covering a much longer arc of the orbit have been secured, but the computations agree in showing that the comet was in perihelion at the beginning of September, that the inclination of the orbit is small (about 14 degrees) and the motion direct, and that the perihelion distance is about one and one half times the earth's distance from the Sun.

It is not surprising that this comet has not been observed at its earlier return, for (as the diagram published last month clearly showed) the present appearance was so timed that the comet came about as near as possible to the Earth at the same time that it was nearest the Sun, and so appeared as bright as it was possible for it to seem. Even so, it was only of the magnitude 11.5, and is now a good deal fainter. If it had come along six months earlier or later, when the Earth was on the opposite side of the Sun, it would never have appeared brighter than the fourteenth magnitude, and would have almost certainly escaped discovery.

The most remarkable thing about it is its telescopic appearance. Prof. Aitken of the Lick Observatory (a very experienced observer of comets) says concerning this: "In the moonlight the object showed very little resemblance to the ordinary comet. It had the appearance of a star of magnitude 11 or 11½, with no more than the merest suspicion of nebulosity. Indeed, it was only detected by its motion." Later, on a dark sky, "a faint brushy nebulous extension, like a short tail, was seen to extend three or four minutes of arc to the southeast from the nucleus." No wonder that Prof. Aitken declares, "I have never seen an object like it." It will be of great interest to learn just what the character of its orbit will finally prove to be. If the shorter of the computed periods is correct, it will have almost as many points of resemblance to an asteroid as to an ordinary comet.

The ephemeris now at hand for this comet runs out in the middle of October, but by approximate extrapolation it would appear that on October 30th its position should be in 23 hours 36 minutes R. A. and 15 degrees 17 minutes north declination; and its motion a little east of northward, at the rate of about eight minutes of arc per day. It will, however, be of no use at all for the amateur with a small instrument to attempt to find an object which, when brighter, could not easily be identified with the great Lick telescope.

The third comet now in view—discovered by Delavan at La Plata, Argentina, on September 26th—is the most interesting of all, for it was at once recognized as the return of Westphal's comet of 1852, for which astronomers had been on the lookout for some time. This comet was discovered on July 24th, 1852, by Westphal at Göttingen, and observed until January 11th of the following year. When nearest the Earth it was easily visible to the naked eye, and had a tail about a degree in length. The observation secured at that apparition left no doubt that its orbit was an ellipse, and its period about sixty years. All the available data were rediscussed a few years ago by the Austrian astronomer Hnatek, using all needful refinements of calculation, and allowing for the perturbative effects of the attractions of Jupiter and the other planets. He concluded that the period indicated by the observations as most probable was 61.71 years, but that any period within six months or so of this might be assumed without doing violence to the observational data.

The orbit of Westphal's comet.

For a year or two back, Hnatek has published "search ephemerides," telling when to look for the comet on various hypotheses regarding the actual length of the period. As soon as Delavan's discovery was announced, it was seen that his comet was in the right place, and when it appeared that it was moving in the right direction and at the right rate, there remained no doubt as to its identity.

An independent calculation of its orbit, made at the University of California on the basis of the first week's observations, assuming only that the period of the orbital motion was known, yields values of the other elements agreeing closely with those of the comet of 1852, and shows that the exact length of the revolution just completed is 61.118 years, the comet returning to perihelion on November 26th.

The orbit of this comet, with those of the planets from the Earth to Uranus, is illustrated in the annexed diagram. The comet's orbit is supposed to be in the plane of the paper, and to be seen "in plan," while the orbits of all the planets are seen partly edgewise, and hence appear elliptical, though really almost circular. They actually lie in a plane inclined about 41 degrees to that of the comet's orbit, so that the parts of the orbits drawn in the diagram with full lines must be supposed to be above the paper, and the dotted parts below.

With this explanation it becomes apparent that the comet's track passes very near to those of Mars and Jupiter, and fairly near that of the Earth, and that it can never come at all close to any of the other planets. As in many other cases, the close approach of its orbit to that of Jupiter is probably by no means a matter of chance. It is well known that if a comet passes near this great planet, the influence of his attraction may radically modify its orbit, changing it from the original parabola into an ellipse, if Jupiter's attraction slows the comet's motion, or into an hyperbola, if it accelerates it.

After such an encounter, the comet will pursue a new course, which, since it passes through the place of meeting, must of course come close to Jupiter's orbit. For many revolutions the comet's track may now suffer little change, if it does not pass the critical region at the same time that Jupiter does; but the telltale nearness of the orbits will preserve the history of the past vicissitudes.

It is probable that most, if not all, of the comets of short period got into their present orbits by this process of capture; and in the case now under consideration we can say with some confidence that Jupiter was the capturing body. Mars, though it may sometimes come almost as near the comet as Jupiter, has so small a mass (only about 1/3,000 that of Jupiter) that its attraction is relatively quite ineffective.

Of course, the encounter which originally changed the comet's orbit may be repeated at any return, and sooner or later is bound to be repeated. The two bodies, some time or other, will come to the junction point almost at the same time, and the comet's orbit will again be greatly changed. It is practically an even chance whether the comet will be accelerated—making the orbit much bigger, so that it returns at longer intervals, if at all—or retarded, in which case the ellipse again grows smaller, and the period shorter.

Westphal's comet will not come at all uncomfortably close to Jupiter on this return, nor did it at the last. To attempt to calculate what happened longer ago by carrying back the present period would be illusory, for, even if the comet did not come very near one of the great planets, their attraction (as in the similar case of Halley's comet) may cause the intervals between returns to vary by many months.

The comet itself is not a large one and would be a faint object if it, too, was not favorably placed with reference to the Earth. The various estimates of its brightness made soon after its discovery indicate that the central nucleus was of about the eleventh magnitude, while the whole brightness of the head was about the eighth magnitude. Theoretically, this brightness should increase but little, for the comet was at its nearest to us just after its discovery and is now slowly receding. But it is still approaching perihelion, and the light of a comet usually increases rapidly as the Sun's rays act on it with growing intensity. Toward the end of November, the conditions are almost as favorable as they were in 1852, when the comet was about of magnitude 4½, so that it may become visible to the naked eye. In any case, it will be a pretty object in even a small telescope. Even at the end of September, it showed a bright, round coma, and a tail which could be followed visually for a degree or more.

From the ephemeris published by the workers at the University of California, the comet's position will be as follows:

	R. A. h.	R. A. m.	Dec.
November 1.....	20	38.3	+ 24° 31′
November 9.....	20	33.5	+ 29° 14′
November 17.....	20	32.1	+ 33° 34′
November 25.....	20	32.9	+ 37° 45′
December 3.....	20	35.0	+ 41° 53′

(Concluded on page 35.)

At 11 o'clock: Nov. 7.
At 10½ o'clock: Nov. 14.
At 10 o'clock: Nov. 22.

At 9½ o'clock: November 30.

At 9 o'clock: Dec. 7.
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 23.

NIGHT SKY: NOVEMBER AND DECEMBER

The Blowing Up of Gamboa Dike

Flooding Culebra Cut With Water from Gatun Lake

WHEN the Panama Canal is opened for traffic its shipping will pass from ocean to ocean through a fresh water canal, formed by the damming of two rivers, the Chagres on the northern side of the continental divide, and the Rio Grande on its southern side. The waters of the Atlantic will never, as is popularly supposed, mingle with those of the Pacific; for, although the canal will serve to connect the two oceans by permitting the passage of shipping from the one to the other, their waters will never unite. There are two salt-water sections of the canal, one extending for seven miles to Gatun locks, on the Atlantic side, and the other, on the Pacific side, reaching from Miraflores locks for a distance of 8½ miles to deep water in the Pacific. The intervening 35 miles will consist of fresh water. If it should be decided in the far future to cut down the canal to sea level, salt water would then be free to flow from one ocean to the other.

The thirty-five miles of fresh-water canal consists of two lakes. The larger, Gatun Lake, lying to the north of the divide, has been formed by the erection of a dam at Gatun. It will be maintained at the desired elevation of 85 feet above sea level by the continuous inflow of the Chagres River, whose waters will pass slowly to the Atlantic, part of them finding their way through the locks, part of them over the spillway in the center of Gatun dam, and a considerable portion being lost by evaporation from the far-spreading surface (163 square miles) of Gatun Lake. At the southerly end of the lake is the nine-mile Culebra cut through the divide. The water in this cut will be at the same level as the lake, and this level terminates at the Pedro Miguel locks, through which shipping will be lowered 30 feet, to enter a small lake formed by damming the Rio Grande River. The ship channel through this lake is about a mile and a quarter in length, and at the southerly end it enters the Miraflores locks, in which ships will be lowered to the level of the Pacific Ocean. The Rio Grande River will continue to flow to the Pacific through the lake and locks or over the Miraflores spillway.

As everyone knows, the heaviest work of excavation was done in cutting through the continental divide at Culebra. Work on the cut was begun by the French on January 20th, 1882, when the following cable was sent from Panama to the *Bulletin du Canal Interoceanique*, which was published in Paris by the French company: "The first work on the great cut of the maritime canal was formally inaugurated to-day in the presence of the dignitaries of the State, the leading citizens of the city and the great assemblage of the people. The first locomotive has arrived at the newly opened excavation. The city of Panama is celebrating the event with a grand fete."

During the intervening thirty-two years, about 100,000,000 cubic yards of material has been taken from the great excavation; and the practical completion of the work was celebrated at 2 P. M., October 10th, when President Wilson in Washington threw a switch which, through the medium of the telegraph and cable lines, touched off a blast of 40 tons of dynamite, and made a breach in the Gamboa dike, which during the progress of the excavation had served to keep the rising waters of Lake Gatun out of the cut.

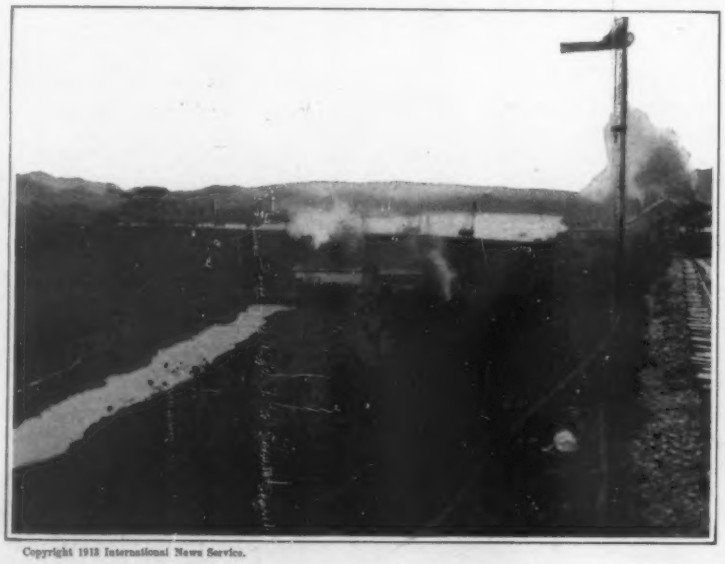
The Chagres River, which in the rainy season is subject to floods of great magnitude, flows in from the west and intersects the line of the canal at the northerly end of Culebra cut, where it swings to the north on its way to the Atlantic Ocean. On the southerly side of the river, a massive embankment of earth was built across the canal, and raised to a sufficient height to prevent its being overtopped by the heaviest floods of the Chagres. Under the protection of this dike, the Culebra excavation has been carried on in the dry by steam shovels, of which at one time there were as many as forty-one working in the cut.

When the Gamboa dike was built, means had to be provided for getting rid of the drainage in the nine-mile length of the cut. This was done by laying four 26-inch iron pipes through the bottom of the dike, and building a pumping plant to draw the water from the cut and discharge it into the Chagres River on the opposite side of the dike. When the excavation of the cut was practically completed, and the steam shovels, locomotives, and dirt trains had been removed, together with the tracks and various equipment, the first step toward filling the cut with water was to open the drainage pipes and allow the water to pass into the cut from the lake. This was done to provide a cushion on the inner side of the dam and localize the effects of the explosion. Over one thousand holes were drilled in the dike and each was loaded with from eighty to one hundred pounds of dynamite. Many a big blast had been set off during the construction of the canal, but this one, consisting of forty tons of dynamite, was the largest.

On the first page of this issue is shown an instantan-

After the explosion a great cloud of gases hung over Gamboa dike.

Gatun Lake and the westerly half of the big dam, which is 115 feet high and 2,000 feet wide.



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Gamboa dike, from Culebra cut, before explosion.

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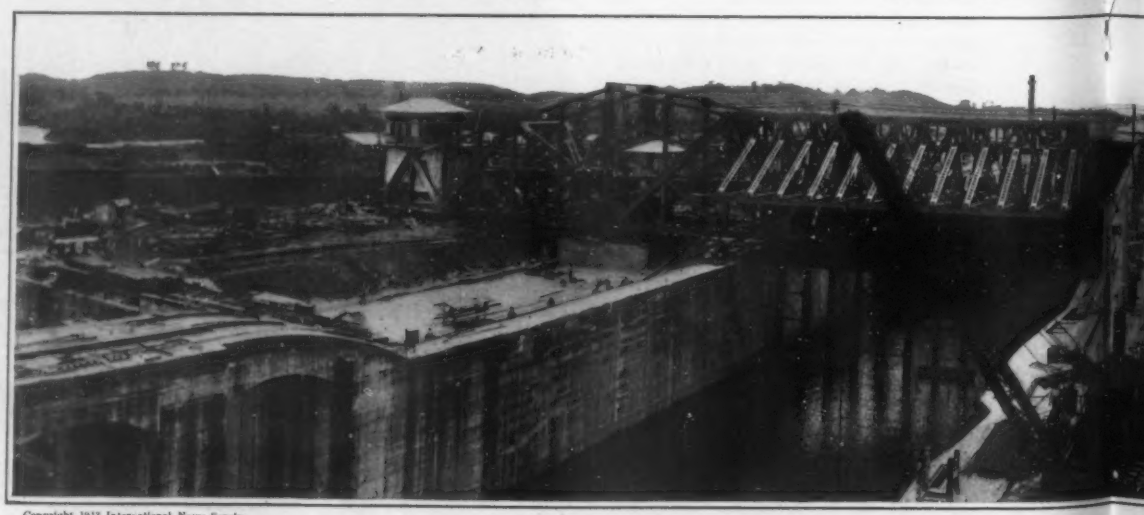
Upper locks, Gatun. Note electric



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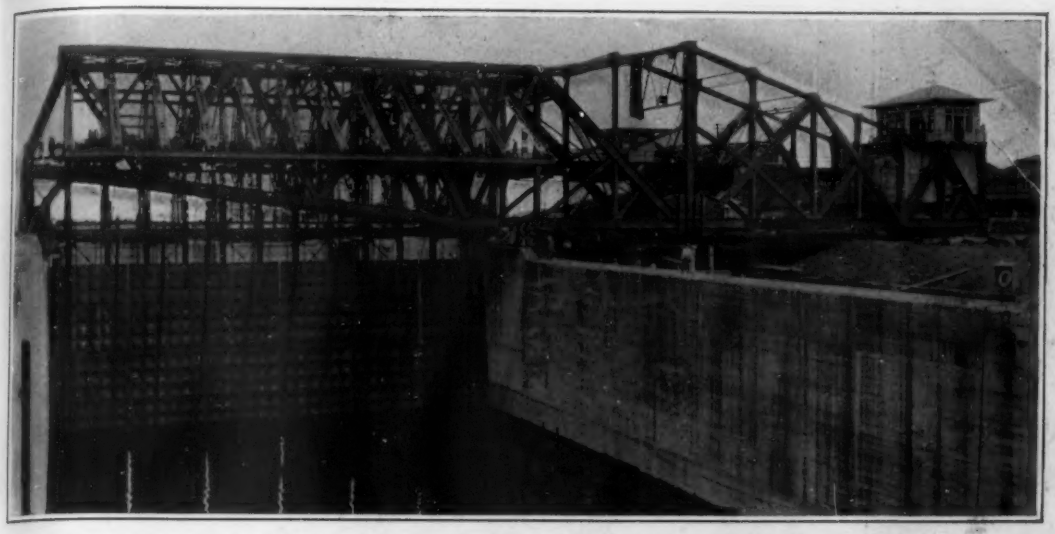
At left is a movable dam swung across entrance, with wicket girders lowered. At right is a similar dam in normal

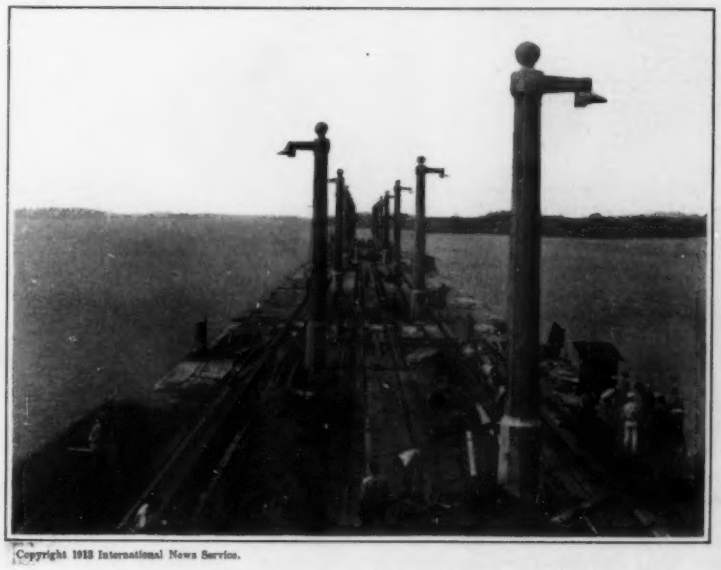
GATUN LOCKS, LOOKING TOWARD ATLANTIC ALO



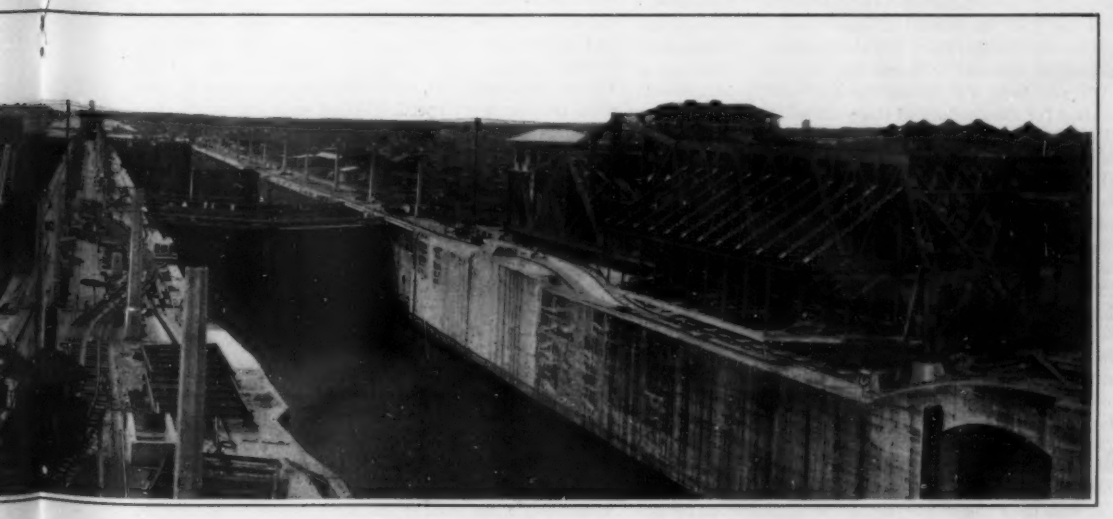
This view shows the steel plates of emergency dam lowered, shutting off Gatun Lake from the locks.

Gamboa dam after the explosion; water flowing into Culebra cut.

Note electric light standards.



Center wall of Gatun locks, looking toward the lake.



in normal position, parallel to the lock. These dams would cut off Gatun Lake in case the gates were carried away.

NTIC ALONG THE AXIS OF MIDDLE WALL

eous photograph of the detonation, and another photograph shows the vast clouds of gases which hovered above the breach that had been opened. The difference of level in the lake and in the cut was not sufficiently large to produce a very heavy rush of water, and no damage was done either by the explosion or the subsequent filling of the cut.

After the excavating plant had been removed from the cut, the troublesome Cucuracha slide continued to flow into the canal prism, and when the water was admitted the material had entirely filled the canal up to a height of nearly eighty feet above sea level, or within a few feet of the ultimate level of the water when the lake is full. As soon as the floating dredges have taken out what remains of the dike they will proceed seven miles to Cucuracha slide, which of its own volition is now performing the work that was formerly done by Gamboa dike in holding back the waters of the lake. When the slide has been dredged out, the water will fill the entire cut from Obispo to Pedro Miguel locks. The floating dredges will be concentrated at Cucuracha, and it will not be long before they have cleared the channel sufficiently for the passage of such shipping of the canal construction equipment as may wish to pass from ocean to ocean.

The Channel Tunnel

AT the first Franco-British Touring Congress, held at London, Baron E. d'Erlanger read a report before three hundred members upon the present status of the proposed Channel tunnel. Speaking first of the history of the formation of the first tunnel company in 1876, soon after the difficulties of a diplomatic order had been overcome, he then referred to the projects of the present company. Construction work and expenses of the tunnel will be divided into two equal parts. The English and the French companies will thus be required to build about 12½ miles of tunnel and to furnish a capital of $40,000,000. He then dwelt upon the advantages which would be afforded by a tunnel connecting France and England as regards touring and from a commercial and military standpoint. Danger to England from an invasion from the Continent, which is one of the main objections to the enterprise, would be avoided by establishing forts around the English entrance, and also by taking the proper measures of construction so as to put the tunnel out of use in a few minutes. In case of need, the most effective means will be to fill up the tunnel with water. The project is one which is specially interesting from an industrial point of view, but also has a wider scope than mere pecuniary gain, as it will be an important factor in uniting the two nations.

The Chronology of Aviation

THE SCIENTIFIC AMERICAN has received from Mr. Hudson Maxim and Mr. William J. Hammer a limited number of the reprints which they have just issued of the very complete "Chronology of Aviation," originally prepared by these gentlemen for the *World* Almanac of 1911. The data embrace the essential facts relating to aerial progress. In addition to a short historical *résumé*, one finds herein tables giving altitude records, speed records, quick starting and slow-speed records, passenger carrying, English Channel and other over-water flights, cross-country flights, notable distance and duration flights, etc. There are also statistics relating to accidents and data relative to spherical and dirigible balloons or airships, etc. Of no small interest are the tables giving the most important flights of the Wright brothers. There are doubtless many readers of the SCIENTIFIC AMERICAN who are much interested in this subject and who would be glad to secure a copy of this interesting brochure. They can do so by applying to the Aeronautic Editor of the SCIENTIFIC AMERICAN, 361 Broadway, New York.

The Current Supplement

IN this week's issue of the SCIENTIFIC AMERICAN SUPPLEMENT Messrs. Langmuir and Orange conclude the report on their researches on the causes of darkening of tungsten lamp bulbs and the methods devised to avoid this type of deterioration.—Dr. A. Gradenwitz describes the new aquarium recently completed in the German capital.—A. Lockett, tracing the historical evolution of the modern stereoscope, tells the reader many facts about the instrument which are not very generally known.—L. Wilbar contributes an article of peculiar interest on the controversy as to the reasons for the geographical distribution of the puma and the jaguar.—A very excellent and highly instructive set of road models prepared by the Office of Public Roads is illustrated and described.—Dr. A. D. Little, in his presidential address before the American Chemical Society, gave an excellent exposition of Industrial Research in America—what it has done and is still destined to do for this country. Extracts from this paper appear in this week's issue of the SUPPLEMENT.—J. J. Ide contributes an illustrated article on the Nieuport monoplane.

The monotype keyboard. Making the record.

The monotype casting machine. Reversing the record.

The Principle of Reversal

A Suggestion For Inventors

By Henry Harrison Suplee

IT is beginning to be understood that one of the greatest methods of conserving human energy and of using it to maximum efficiency, lies in the employment of methods and apparatus for enabling the skill of the trained man to be used repeatedly by others who are less skilled; or even by the employment of wholly inanimate machinery. This is only an extension of the tremendous step which was made when the discovery of writing, and its follower, printing, enabled the experiences of men to be recorded and accumulated; but it includes also a discovery, much more recent in point of time, that the most efficient method of recording is that which, by the operation of reversal, may be made to repeat the recorded operations indefinitely.

Although this idea of making records in such a manner that they may be used to repeat the operations which originally produced them, has been known for many years, its practical applications have been comparatively recent. Preceding such automatic methods, there appeared the germ of the process in such devices as the musical box, in which pins, placed upon a revolving cylinder, enabled melodies to be produced repeatedly. Similar devices are found in certain tools, in which carefully formed cams are used to permit a definite sequence of operations to be conducted according to a predetermined plan; while the operations of the perforated cards of the Jacquard loom, and of the various devices for playing upon the piano, by means of perforated rolls of paper or metal, are well known.

In most of these devices, however, and of those based upon them, the original record is made by carefully operated tools of special design beforehand, but even under such conditions, they are of the utmost importance as indicating a principle which should be more fully appreciated than it now is. The true method for using the skill of the trained man does not lie in employing him to do over and over again the things which he can do so well; it lies in getting his skill recorded upon such special pieces of mechanism as can then be employed in doing the work just as well, without the intervention of human skill. The able man should be used to do a thing exceedingly well, once for all, and thereafter it should continue to do itself, wholly independently of him or of any other skilled workman. It is in this way that the trained designer prepares the cards for the Jacquard loom, or the skilled operator prepares the roll for the pianola or the monotype, and by more recent extensions, the perforated card enables the tabulating machine to sort and classify the original data for the national census, or for the railroad auditor.

The principle of reversal, however, extends still further, and makes the original record its own translator. A number of years before the invention of the phonograph, there was devised an ingenious machine, invented by M. Leon Scott, and called the phonautograph. This device resembled the phonograph very much, except that the recording stylus was a stiff bristle and made its record upon a cylinder which was covered with a coating of lampblack smoke. When any spoken or sung sounds were delivered into the funnel, the stylus made a record of undulating lines upon the smoked surface of the revolving drum, and numerous ingenious and partially successful attempts were made to translate these waves into the sounds by which they had been produced. Success was attained, however, only when Edison applied the principle of reversal, and made a machine in which the indentations in a recording cylinder were made to reproduce the vibrations by which they had been originally produced; thus entirely eliminating any intermediate process of translation. The detailed operations by means of which the original sounds, mechanically impressed upon the original cylinder, are converted back mechanically into sounds similar to those first made, need not be considered by the designer. It is sufficient for him to realize that his correct procedure is to set them to work backward, and make them give back just what was put into them, and this it was which made the phonograph, in all its various modifications, a master example of the modern principle of reversal.

In the case of the mechanical apparatus for reproducing music upon the piano or organ, a similar principle is being invoked. Instead of making the record by a mechanical transcription from the written sheet music, it is now possible for the musician to perform upon a recording instrument, and the marks thus impressed upon a moving strip need only to be cut out to enable any player-machine anywhere to reproduce the original record thus made.

One of the most extensive illustrations of this principle of reversal now in existence appears in the case of the cinematograph, or moving-picture machine. Here a number of trained performers, with all necessary accessories, are employed, at a very considerable expense, to produce the original record; but once produced, it may be repeated indefinitely, with every detail of movement, facial expression, and even coloring, in as many places as may be desired, with no further effort on the part of the original actors, who, in fact, are thereafter occupied in producing other films, and in doing once for all, things which are then capable of repeating themselves indefinitely thereafter.

We see here the possibilities of the principle of reversal for the conduct of the work of the world, especially as it relates to the greater utilization of individual skill and judgment. It is most inefficient to compel a skilled man to continue repeating the effort of his own hands, guided by his own head, when with proper mechanism he should be making records which would do the work as well and far more productively.

The modern system of scientific management recognizes this principle, in a crude and limited way, by the employment of a planning department, of which the function is the preparation of instruction cards and information, to be closely followed by the workman to enable maximum production to be realized. The workman, being stimulated by a wage system based upon productivity, and guided by the instructions of the planning department, is thus supposed to be enabled to attain maximum efficiency.

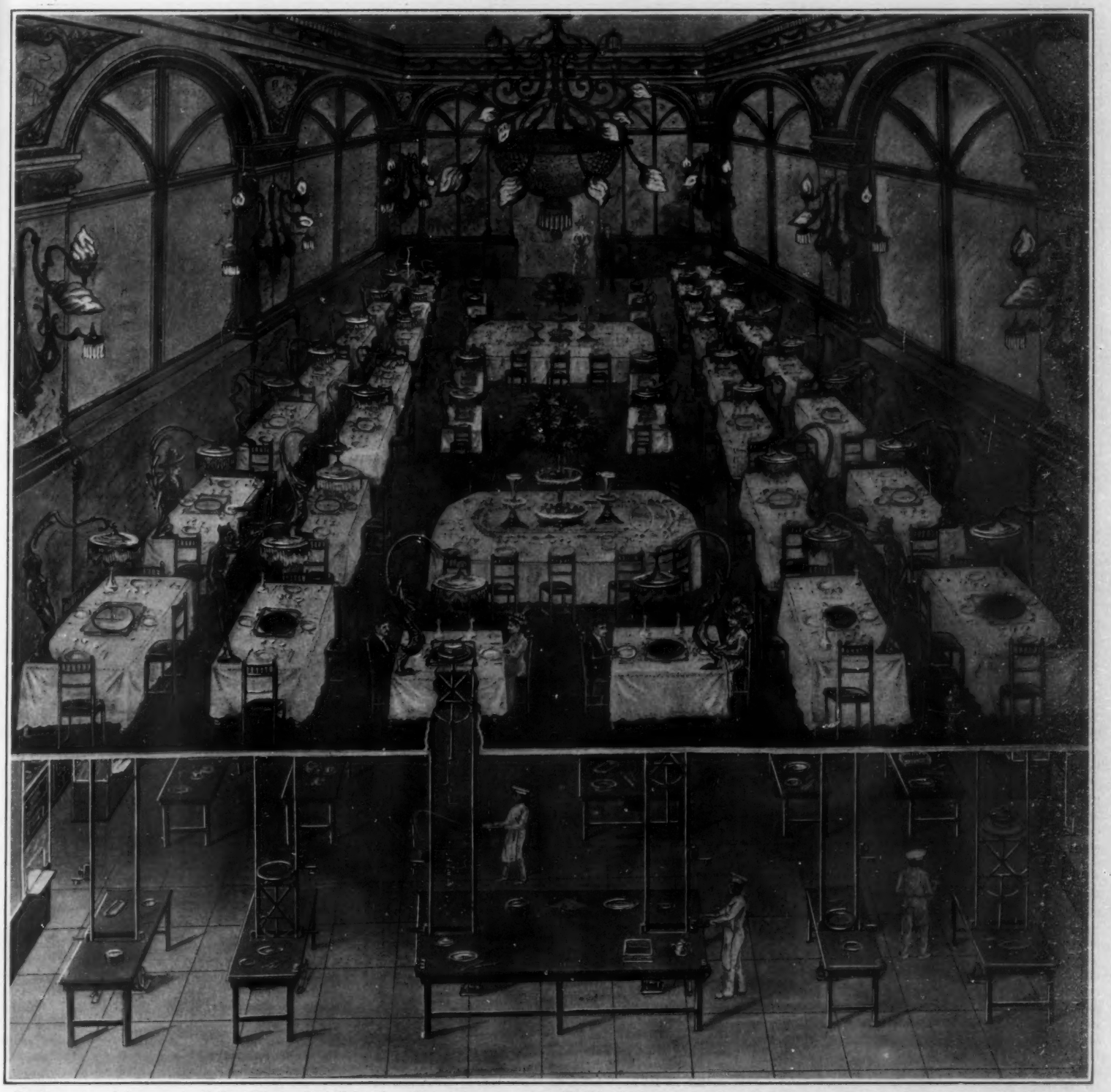
It has been remarked that such a system makes of the workman nothing less than a machine, and this being the case, it remains to push the method a little further, to its perfectly legitimate conclusion, and make it possible for the planning department to reduce its instructions to a mechanical record which, when placed in the tool, in a manner similar to that followed in the Jacquard loom, or the monotype composing machine, shall proceed without any human supervision whatever. That this can be done must be conceded, since it is evident that no machining operation is so complicated, either in sequence of movements or in timing, as is found in an elaborate modern musical composition. Furthermore, it is possible to speed up the performance of a mechanical record to a rate far higher than that at which it was originally made, the limit in this case being, not that of the workman, but of the inertia and frictional resistance of the machine. When a number of machines are to be employed in making identical objects, it is entirely possible to use one master record for all, using duplicate records for the several machines, or, by electric or pneumatic communication, employing one record to govern all the machines.

In the production of a master record by the skill of a trained workman the time employed in making the original is wholly secondary to its perfection. A man may well spend hours over the permanent record of a few movements when he knows that it is to be reproduced precisely thereafter by hundreds of machines at speeds far exceeding the possibilities of direct human control.

Following out the principle of reversal, however, the apparatus upon which the skilled operator is employed, should contain within itself the recording mechanism, and thus there may appear a new system of machine tools, consisting of a single master record-making machine, to be operated at slow speed by a skilled workman, this apparatus being employed wholly in making records to be translated by a battery of reproducing machines engaged in productive work. The master machine should produce a perfectly finished piece, being governed and controlled by the trained operative, and run as slowly as may be necessary to insure perfection in the product and in the accompanying record. The reproducing tools, once supplied with records, may then be driven at speeds limited only by mechanical considerations, such as the amount of power required, the resistance of the material employed, and the inertia effects of moving parts.

There is no more need for the skill of a man's hands to die with him than for the printed record of his thoughts to vanish from the page when he leaves this earth. The movement of the hands, as well as the word spoken by the lips, may become as effectively recorded for future service hereafter as the written word or the printed page.

An Alarm That Rings Forty-eight Hours.—An inventor has designed an alarm for automobiles with the object of discouraging the car thief. It is claimed that tampering with the car in any manner without first using the key which controls the device, releases the alarm to ring for forty-eight hours, short circuits the ignition wires and turns off the gasoline. Since it is claimed that the alarm cannot be stopped until two whole days have passed, a thief could not get very far with his stolen car.



Restaurant and basement of the "Electro-Feria" hotel. All services are centralized in the basement, where the apparatus for use of restaurant and bedrooms is conveniently arranged for supplying any guest by pressing a few electric buttons.

An Electric Hotel in Paris

By Jacques Boyer

M. GEORGIA KNAP, the inventor of the electric house which was described in the SCIENTIFIC AMERICAN of December 4th, 1909, proposes to erect, in Paris, a hotel, which will be a marvel of electro-mechanics.

In this hotel, for which the name "Electro-Feria" has been chosen, all of the services are centralized in the basement. Here all of the apparatus required for the service of the restaurant and the bedrooms is arranged so conveniently that the operator can promptly supply the needs of any guest by pressing a few electric buttons. Three or four minutes are occupied by a maid in carrying up breakfast or the morning mail to a guest lodged on the third floor. With the electric system the same service can be performed in ten seconds by an almost motionless operator.

When a guest awakes in the morning his first desire is to know what time it is. Without rising, he touches a button at his bedside and immediately the time appears on a large luminous dial projected on the ceiling. If it is time to begin the new day, another button is pressed and a voice, issuing from the electric chandelier, asks what is wanted. The guest, still lying in bed, calls out to the ambient air, without using a telephone: "Open the curtains and shutters. Let in the air; it is too warm. Send me a cup of coffee and my letters," etc. These orders are promptly obeyed. The curtains and shutters open and flood the room with light. The top of a chiffonier, placed beside the bed, turns and extends itself over the bed to form a convenient table. The breakfast and the letters appear on the chiffonier, and, in less than a minute, all of your desires are satisfied, for your room is connected directly with the basement, where the operator has at hand the means of furnishing everything that you require with a minimum of delay and exertion.

The restaurant of the hotel is served in the same manner. Each small table, for two or four persons, is provided with a dictagraph, which is placed in the lamp shade. You touch a button and a voice from the lamp shade asks what you wish. You give your order in a loud voice, without putting your mouth to a telephone. A silvered platter in the center of the table sinks and presently re-appears, laden with the food you have ordered. As soon as you have helped yourself, the platter again sinks and in twenty seconds returns with the dishes ordered by your neighbor. The plates, etc., are changed, in a very convenient and practical manner, by means of a little dumb-waiter with shelves.

The promptness and rapidity of the service are due to the ingenious arrangement of the basement. The kitchens are close beside the service elevators. The serving tables and dish racks are placed at intervals of sixteen feet, and each supplies ten restaurant tables, or forty guests, who can thus be served by a single waiter In addition, an "omnibus" waiter is provided for every eighty guests, for the work of changing plates, etc.

Each guest receives, with his order, a check which is numbered to correspond with his individual push-button. Payment may be made to a cashier at the door, or by means of the service elevator, according to the system adopted.

Tables with twelve seats, for dinner parties, will be operated in the same manner, except that each dish will move along the table to the person who has ordered it, guided by the unseen *maitre d'hotel* with the aid of a wide-angle periscope.

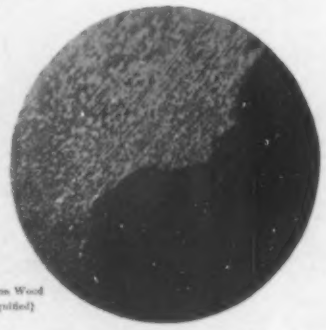
The visitor to the basement will see dishes of food coming automatically from the adjacent kitchens to the hundreds of little elevators that communicate with the restaurant and the apartments, and soiled dishes going automatically from the elevators to the electric washing machines.

The plan adopted for the electric hotel is the result of long study and research on the part of its projector, M. Georgia Knap, in collaboration with M. Danger, the well known Parisian architect. The bedrooms are constructed and arranged on an ingenious system which allows the little elevators to reach the rooms without wasting space or making themselves conspicuous. The rooms are separated by corridors two feet wide, in which the electric wires and the hot and cold water pipes are placed. There are no radiators in the rooms, which are heated by a novel system involving no complicated apparatus. Danger of fire is eliminated by placing all wires and pipes in conduits of fiber-cement.

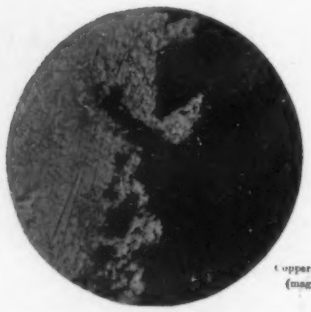
Metal Plating With the Air Brush

The Remarkable Results Obtained With the New Schoop Process

How Pulverized Metal is Sprayed on Objects by a Novel Invention



Lead on Wood (magnified)



Copper on Metal (magnified)

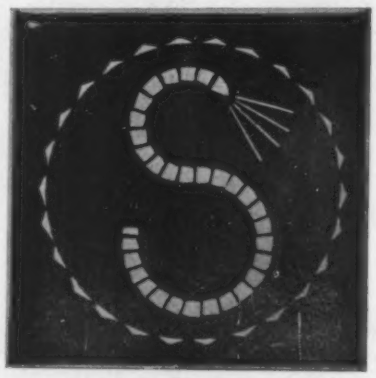
A NUMBER of processes for depositing a coating of metal upon the surface of objects—usually themselves made of metal—have been well established for many years past. The principal of these are the electrolytic method of plating, and the application of a coating of melted metal, as in the so-called process of "galvanizing" iron in the manufacture of tinplate.

But these processes have their disadvantages. Electro-plating is a somewhat delicate, and at the best a slow operation. Galvanizing, too, is not altogether a simple operation, and many hitches are liable to occur in the process. At the best it is crude, the product is not very stable (tinplate rusts rather easily, as every one knows) and delicate objects, with fine markings or re-entrant corners, can not very successfully be treated by immersion in a bath of molten metal.

We have had occasion to refer to the new process invented by the Swiss engineer, Schoop, which not only is free from the disadvantages pointed out above of the older processes, but which has a practically unlimited field, owing to the ease with which it is carried out and the fact that it can be applied to literally any surface whatever. A molten metal bath can evidently be used only in dealing with metals or other resistant materials. An article in order to be capable of being electroplated must be conducting at least on its surface. But Schoop's process will coat any surface, however perishable or fragile (paper, lace, etc.) in the briefest time with a perfect metal coating.

Several types of apparatus have been devised for carrying out the process, but in its most perfect form the instrument employed is a "pistol" held in one hand, and provided with an oxyhydrogen blast, which progressively melts a metal wire fed to it, while an air blast sprays the melted metal against the surface to be coated.

An idea of the applications to which the process can be put may be gathered from the examples shown in several of our engravings. *Objets d'art* molded from any material whatever, such as terra cotta, cement, etc., and coated with a film of metal, form exceedingly attractive ornaments. But probably the most important use of the process will eventually be its application in the industrial arts, for lining vessels to make them resistant to various liquids and reagents, for coating structural work, such as iron bridges, to protect it from the weather, and for innumerable analogous purposes. The coating prepared by Schoop's process adheres tenaciously to the surface upon which it is deposited. This firm grip is explained when we look at the microphotographs on this page, which show how the metal forming the outer coating forms an intimate bond with the surface of the underlying material—copper in one case and wood in the other.

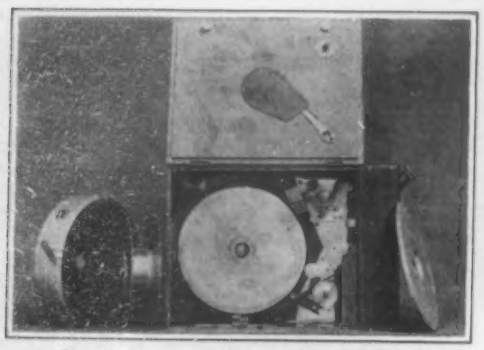


Trademark made by spraying tin through a stencil on terra cotta.

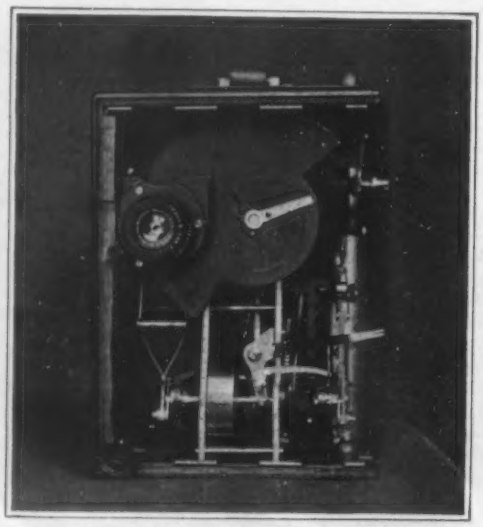
A terra cotta urn and a cement lion, both covered with brass and polished.

The Schoop process is still in its infancy, at least so far as its application in the arts and industries is concerned, and there is every reason to expect a wide field of usefulness for it in the future.

But while the coating obtained by direct spraying of an unprepared surface adheres thus tenaciously to the substratum, it is quite a simple matter to obtain a detachable casting or mold if the surface is previously prepared with graphite, talcum or grease. And the mold can be made just as thin or as thick as desired by simply regulating the length of time of spraying. It is needless to point out the many possible applications of this form of the process.



The film boxes and internal mechanism.



Front view showing the air motor and gyroscope.

A Cinematograph Hand Camera

By the English Correspondent of the Scientific American

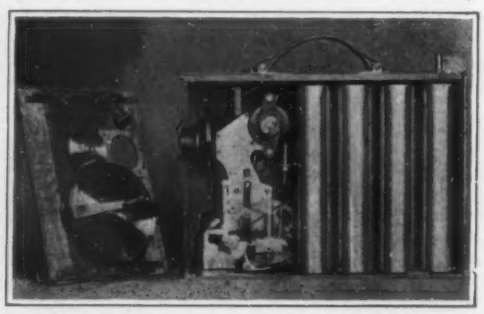
DURING the past few years the increasing demand for topical and big-game, or hunting, motion pictures has emphasized the shortcoming of the conventional apparatus for such work, and the need for some compact, light instrument which can be handled with the simplicity and ease of the ordinary snap-shot apparatus. The first commercial success in this direction has been achieved by Mr. Proszynski, the Polish scientist resident in England, who has perfected such an instrument, which is known as the aeroscope.

The camera is driven by compressed air and is absolutely automatic in its operation, the exposures being made regularly at the desired number per second, all the while the control button is depressed, and so long as there is sufficient air in the reservoirs to drive the mechanism. The instrument, measuring 12 inches in length by 8½ inches in width by 6½ inches deep and weighing 14 pounds, is entirely self-contained. It is fitted with separate film boxes inside the camera, any number of which may be carried and changed in full daylight like the common snap-shot camera spool. When loaded, the camera normally has 300 feet of film in the spool-box, and the air reservoirs are of sufficient capacity to enable 600 feet of film—two boxes—to be exposed upon a single charge.

Externally the camera resembles the ordinary snap-shotting instrument, with the exception that on one side is the film counter, while on the other is the air-valve, the speed regulator, and the starting button, together with view finders. On the top is the indicator notifying the volume of air remaining in the compressed air reservoir. The camera is divided into two main compartments. One contains the film boxes, access to which is provided by means of a side door, while the other contains the intermittent film-moving mechanism, the motor, air cylinders and a powerful gyroscope. If desired, the whole of the internal mechanism can be withdrawn intact in a few moments for the purpose of cleaning and overhaul, and without disturbing a single component part.

The compressed air is contained in four cylinders placed side by side and interconnected, so that as soon as one is exhausted the next comes into action. The air reservoirs are charged by means of an ordinary

(Concluded on page 354.)



Side of camera removed to show air cylinders.

RECENTLY PATENTED INVENTIONS

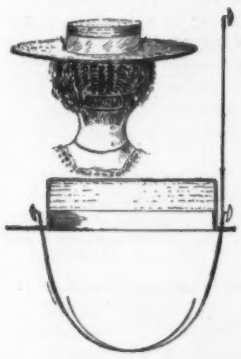
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

HOOD AND NECK PROTECTOR.—F. P. FIORI, New York, N. Y. The purpose here is to provide means which may be utilized both as a hood and neck protector, or only as the latter. Further, to provide a protector or muffler designed to fit around the neck and to carry a hood which is adapted to be folded to a position in the protector when not in use.

WOVEN TUBULAR TIE.—J. C. GAYNOR, 465 E. 31st St., Paterson, N. J. The invention relates to a weave and a product secured thereby, and provides such a woven fabric as to produce spaced tubular members in continuous fabric. It also provides a fabric in a continuous strip arranged with spaced tubular portions and an extra or supplemental portion opposite each tubular portion.

HAT FASTENER.—EMMA T. MILLER, 812 Main Ave., San Antonio, Tex. This invention relates to hat fasteners, and provides a simple device by means of which a hat may be se-



HAT FASTENER.

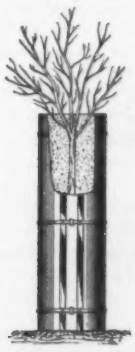
curely held to the head of the wearer, and which may be readily removed from the head without entangling the hair. The device is one which will securely retain the hat in position and which will be removed from sight.

Electrical Devices.

ELEVATOR SIGNALING APPARATUS.—T. PORTER, 272 Dean St., Brooklyn, N. Y., N. Y. The specific object in this case is the provision of an automatic switch in the circuit of each reset magnet for all the push button and signal circuits of each shaft, the switch being preferably a speed responsive device operatively connected with some moving part of the car hoisting mechanism, so that, when the car is stopped, the speed responsive device will close the resetting circuit for the particular signal magnet that has been energized by the pushing of the signal button where the passenger desires to board the car.

Of Interest to Farmers.

TREE PROTECTOR.—C. I. HELM, R. F. D. No. 1, Phoenix, Ariz. It is the design of this invention to provide a protector by which the tree can be thoroughly protected, the protector being adapted to extend from the ground to



TREE PROTECTOR.

the branches of the tree, and to hold a cylindrical body of earth extending around the tree trunk at all sides to the crown and among the branches, as shown in the accompanying illustration.

MOTOR PLOW.—J. N. PARKER, Bedford City, Va. Means is provided by this invention by which the plow can be easily and readily guided. Means is also provided whereby the wheel operating mechanism may be thrown out of gear, either by disconnecting the motor from the gearing or disconnecting one of the traction wheels from said gearing.

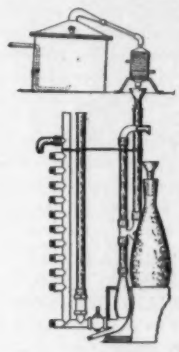
STEAM COTTON BALING TAMPER.—J. L. WALKER, Crafton, Tex. This inventor provides a mechanism for automatically tamping or pressing into bale form cotton as delivered from the gin; provides an operating mechanism for the tamper which is positive in its operation and automatic in its action; and provides means for suspending, during the tamping operation, the feed of cotton to the baling hopper.

FASTENER FOR LEDGER PLATES.—G. E. RODMAN, R. F. D. Box 35, Sunnyside, Wash. This invention relates more particularly to means for securing ledger plates to the guards of mowing machines, reapers, binders, and headers, or any grain or hay cutting machine employing as a part of its cutting mechanism guards and ledger plates.

Of General Interest.

FOLDING DARK ROOM.—J. MASKO, P. O. Box 533, Indianapolis, Ind. This invention is an improvement in folding dark rooms for use for photographic purposes and has for its object the provision of a device, by means of which the development of negatives and printing of prints may be done without the use of a dark room.

APPARATUS FOR RECEIVING, SEPARATING AND FILTERING OILS.—E. MOULIÉ, Jacksonville, Fla. This invention provides an apparatus for receiving, separating and filter-

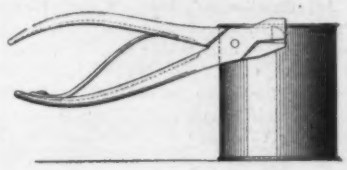


APPARATUS FOR RECEIVING, SEPARATING AND FILTERING OILS.

ing the distillate of volatile and essential oils of all kinds, including spirits of turpentine and oils heavier than water. The apparatus also serves for purifying and filtering all kinds of fixed oils. It operates automatically after it has been started and regulated.

Hardware and Tools.

CAN OPENER.—J. B. LOUREIRO, 15 de Novembro 52, Para, Brazil. The principal object which the present invention has in view is: to provide an apparatus to cut the extended



CAN OPENER.

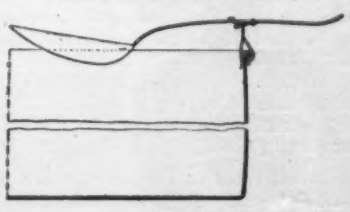
edge of the head or top of a can, to permit the removal thereof. The point is rigidly forced through the metal, when thereafter the curved edge, rising, cuts the metal forwardly. The tool is then employed in a manner usual to pliers or cutting tools of analogous use and construction.

Heating and Lighting.

AUTOMATIC MUD DRUM FOR BOILERS.—A. F. SHREVE, P. O. Box 545, Hoisington, Kan. This invention pertains to mud drums for boilers, the particular purpose being to provide a drum so constructed and arranged as to be automatic in the sense that it operates continuously and positively in the removal of sediments from the boiler.

Household Utilities.

SPOON ATTACHMENT.—J. W. LUNDAHL, Box 585, Thomaston, Conn. The attachment is fixed to the back of a spoon handle and includes a clip adapted to so engage the upper

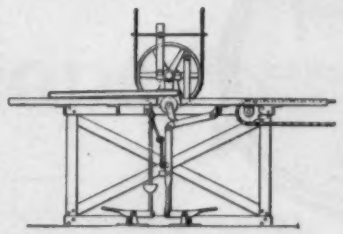


SPOON ATTACHMENT.

end of a pot, pan or other cooking utensil as to sustain the spoon in position and a novel device for securing the clip to the spoon handle, to permit the clip to fold against the handle, when not in use, or to be turned to approximately a right angle to the handle.

Machines and Mechanical Devices.

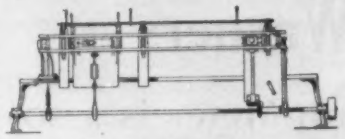
MACHINE FOR STRIPPING OIL CAKES.—T. J. MCNULTY, Brookhaven, Miss. In expressing oil from oil-bearing meal and analogous substances, the meal is molded into flat masses or cakes for introduction into the press, and the cakes are wrapped in press cloths to



MACHINE FOR STRIPPING OIL CAKES.

hold them intact and subjected to pressure. The press cloths envelop the opposite flat side and the two ends of the cakes, the ends of the cloth overlapping usually near the center. The cloths adhere tenaciously to the cake after pressure, and must be forcibly stripped off. The present machine expeditiously removes the cloth without damage either to the cloth or to the cake, and requires a minimum handling by the operator.

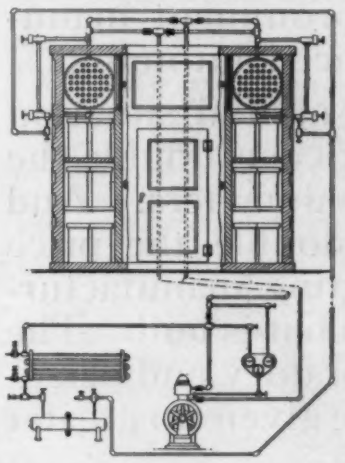
WINDOW JAMB MACHINE.—J. E. EISELE, 2906 Charles Street, Tampa, Fla. An object here is to provide a device for making sides



WINDOW JAMB MACHINE.

of window and door jambs which will dado both ends and cut pockets and pulley openings simultaneously. Another object is to provide a device which will work on right and left jambs at the same time.

REFRIGERATING MACHINE.—J. J. SCHRADE, Waco, Tex. This invention is an improvement in refrigerating machines, and has for its aim the provision of a simple de-



REFRIGERATING MACHINE.

vice of the character specified, adapted to be operated in connection with an ice-making machine, wherein the device is cooled by air circulation, the air being cooled during the circulation.

AIR SUCTION AND FORCE PUMP.—F. O. DE HYMEL, 2323 W. Houston St., San Antonio, Tex. In Mr. De Hymel's application for patent, serial No. 697,183, he disclosed a complete apparatus, a combined pneumatic lift-and-force pump for raising water from wells, the same intended and adapted for service in arid regions. Such apparatus includes the necessary feature of an air-pump cylinder having a reciprocating piston, and possessing certain advantageous features and such cylinder forms the subject of the present application.

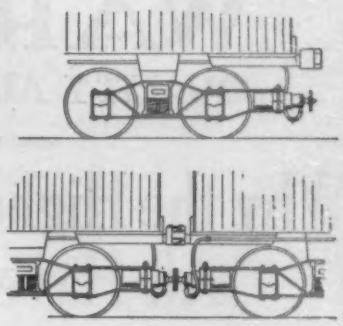
TUBE COILING MACHINE.—J. E. LEWIS, 1601 Moreland Ave., Baltimore, Md. By this invention perfect coils are made without the use of any filling material in the tube; coils may be wound to form spirals of smaller diameter than by the usual, slower method, without collapsing or wrinkling the tubes; and the metal is properly stretched in the bending process, thus imparting to the same a desirable degree of hardness or temper, so that the finished coils are not easily dented or distorted by subsequent handling.

Railways and Their Accessories.

RAILWAY SIGNALING DEVICE.—A. STADLER, care of same, Box 331 Portage, Pa. This improvement provides a set of signals which may be placed on the cab or any suitable place in full view of the engineman, these signals to correspond with the track signals, so that if the latter should be overlooked on account of high speed or heavy fog, the signals within the cab itself will indicate the condition of the track.

RAILROAD SPIKE.—A. F. GOBIN, 1230 Remsen St., Brooklyn, N. Y. This inventor provides a spike having means for receiving an extraneous device operative to connect the spike with the material in which it is driven, at a point below the surface of said material; provides a spike having means for preventing axial movement, or twisting of the same when driven; and provides a spike, wherein the body section conforms with the conventional spike.

AUTOMATIC AIR COUPLING.—F. N. FISHER, Columbus, Kan., care of N. T. Allison, Atty.-at-law, Columbus, Kan. The object here is to provide an air-coupling supported by the car trucks, and in position to be automatically engaged when the cars are coupled and automatically disengaged when the cars are un-



AUTOMATIC CAR AIR COUPLING.

coupled, and wherein means are provided for insuring a correct air connection, whether the cars be on straight, curved or uneven track, which, when attached to a car, does not hinder the air-coupling of such car with cars not so provided.

Pertaining to Recreation.

FLEXIBLE SLED.—J. C. MINISH, Ridgway, Pa. This improvement provides a sled having a positive steering apparatus so as to facilitate the taking of sharp curves. A further object is to improve the general construction of sleds of this type, with particular regard for minimizing the number of the parts.

Pertaining to Vehicles.

DUPLEX DIRT WAGON.—N. B. MCGHEE and REV. ROSAL K. ACUFF, care of the latter, Duncan, Ariz. This receptacle is mounted on wheels for use in temporarily receiving the earth from a grave preparatory to the interment of the dead so that such earth may be temporarily removed from the vicinity of the open grave and concealed during burial services and thus permit of friends and relatives gathering about the grave during services without inconvenience from piling of the earth upon the ground adjacent to the grave and it also insures a sightly appearance of the surroundings during funeral services.

AUTOMATIC CONTACTING DEVICE.—F. MCMAHON, 12 Clay St., Dayton, Ohio. This invention refers generally to electric apparatus and more particularly it involves an automatic contacting device especially adapted for use on magnetos used on automobiles and other structures whereby a storage battery may be conveniently charged therefrom when the magneto has reached a predetermined speed.

SWIVEL LAMP HOLDER.—C. N. SOWDEN, 294 Sherbourne St., Toronto, Canada. In the present patent the invention has reference to means for causing a lamp to be automatically turned in the direction in which the vehicle is turned, so that if the vehicle is turned to the right or left, a lamp will be turned accordingly. Mr. Sowden has invented another swivel lamp holder which is adapted to be mounted on an automobile, locomotive, or other vehicle, and having means whereby the lamp or lamps may be automatically turned in the direction in which the vehicle is turned.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Legal Notes

Copyrighting Moving Pictures.—Since the institution of the law last summer for the protection of motion pictures, only in the neighborhood of 950 applications for copyright registration for the subjects named have been filed. Under the law the application for registration must be accompanied by the title and description, together with one print taken from each scene or act of a motion picture photo play; while a title and description and not less than two prints taken from different sections of a complete motion picture are required if the work be a motion picture other than a photo play.

Continuing Applications in the Court of Appeals.—In the case of Field v. Colman, the Court of Appeals of the District of Columbia in its decision refers to the question of continuing applications. The right of an applicant by substituted application, to relate back to the date of filing the first application for reduction to practice, is held to depend broadly upon whether the substituted application is for the same invention as that disclosed in the original application; not that the specific disclosure of the first and second applications may be different, or even patentably different, if generically they relate to the same invention.

Some Adjudicated Patents.—In National Casket Company v. Stolts, the reissue patent No. 12,750 (original number 619,567), issued to the National Casket Company for a gauze face plate for burial caskets has been held devoid of invention and invalid. The Hildreth patent, No. 832,384, for a candy-pulling machine, has been held void as to claim 4, as broader than the invention in Hildreth v. Lauer & Suter Company. The Fishel design patent, No. 37,055, for a design for clasp pin has been held not infringed in Fishel, Nesler Company v. Fishel & Co. and the Fishel patent, No. 884,979, for a jewel bar has been held infringed in Fishel, Nesler Company v. Fishel & Co.

Adjudication of Hot Water Heater Patents.—In Rund Manufacturing Company v. Pittsburgh Water Heater Company (U. S. C. C. A.) the Rund patent, No. 761,409, for a gas burner has been held valid and infringed and in Rund Manufacturing Company v. Pittsburgh Water Heater Company the Rund patent, No. 903,007, for a water heater has been held valid; also infringed as to claims 3, 5 and 6, and not infringed as to claim 10.

Assignee's Right to Prosecute Application.—Commissioner Moore in *ex parte* Kyle has held that a petition by an assignee of a part interest to intervene in the prosecution of an application will be dismissed where not accompanied by proof of service upon the other assignees and upon the applicant.

A Design Decision.—In the case of *ex parte* Fulda, Mr. Commissioner Moore held that where a design is for the form or configuration or involves the relative proportions of parts of an article of manufacture, such article must necessarily be disclosed in the application, but where the design is for an ornament adapted to be applied to any article of manufacture it is not necessary that applicant disclose the design as applied to some particular article of manufacture. In the decision the Commissioner says while it is possible that applicant might obtain protection for his design under the copyright act, it is believed he is clearly entitled to the protection afforded by a design patent.

Extensiveness of Use in Infringement Suits.—In Stebler vs. Riverside Heights Orange Growers Association it was held that on the question of anticipation the fact that the patented device is so far different from those of the prior art that it has superseded them in general use is entitled to great weight. It was also held in this case that one who appropriates another's invention though he may add thereto another element to perform an additional function, is an infringer; and the Strain Reissue patent No. 12,297 (original No. 720,412) for a fruit grader was held not anticipated, valid and infringed.

Notes for Inventors

A Paper Raincoat.—In a patent, No. 1,055,703, Jacob H. and John H. Brown of Marseilles, Ill., provide a raincoat formed from a single piece of waterproof paper. In making the coat a blank is formed from any suitable waterproof material such as oil paper. The blank has a body portion and lateral sleeve forming portions. An opening with suitable lapels and collar portion is provided with a slit extending to the skirt of the garment, and suitable fastenings are applied for holding the garment closed. The coat can be easily carried in a hand bag or in a package.

A Novel French Life Preserver.—Reports from Havre tell of a life preserver invented by Mr. Allain Redou of the Merchant Marine Service which consists of a garment shaped like an ordinary vest but equipped with inflatable rubber crowns or tubes similar to the water wings popular with American children at the seaside. The crowns are covered with the same material as the vest and each has a rubber tube ending in a pneumatic valve which can be operated by merely blowing into it. Ordinarily the crowns are deflated and can be worn under a coat without attracting attention. In one demonstration a sailor wearing the safety vest had his legs tied together and a weight of twenty-two pounds attached to his feet and when dropped into the water had no difficulty in keeping above the surface. As yet the life preserver is not on the market.

Foreign Artificial Marble.—Consul William J. Pike of Reichenberg, Austria, reports that considerable interest is taken in an invention by a citizen of Reichenberg, Bohemia, of a process of producing marble substitutes in imitation of the highly prized Italian, Egyptian and Salzburg marbles. It is claimed that the product is strong and is not liable to crack. The artificial marble is made partly by hand and partly by machine, while the cutting and polishing is done by machinery. The process is said to be in operation in Vienna, Berlin, Mannheim and Hamburg.

A New Way of Exterminating Vermin.—It is a well-known fact that vermin are attracted by light. A Canadian inventor, Mr. G. A. H. Muller, has patented an insecticide in which that principle is practically applied. He has invented a luminous sticky compound or paint, which does the work of the ordinary sticky flypaper in daytime, absorbs the rays of light at the same time, and becomes luminous at night to finish its work of extermination.

A Nickel-in-the-Slot Typewriter.—Harry Bates of Albany, N. Y., assignor to Underwood Automatic Typewriter Pay Station Company, of New York city, has patented, No. 1,063,948, an apparatus in which a coin controlled typewriting machine is normally out of condition for use and, by the deposit of a suitable coin, can be put into condition for use for a period limited by clockwork, at the termination of which period the machine is automatically locked or returned to normal condition in which it cannot be operated. Such machines can be seen in many hotels.

Aid to the Study of Musical Compositions.—In a patent, No. 1,068,569, Percy F. Cowing of New York city provides a means for the study of musical compositions which includes a record for automatic mechanical instruments. This record is divided into sections or *motifs*, means being provided with matter descriptive of the sections and means being also provided related to the record and to the descriptive matter for indicating their respective relation.

This Shuttle is Self-threading.—Another self-threading shuttle has been patented to George M. Cheney of Southbridge, Mass., No. 1,069,316, in which the bobbin lies in a recess in the shuttle. A thread delivery passage has a threading slit connecting the recess, and a thread delivery passage with an open delivery eye at the mouth of the passage is located to one side of the slit and passage with projections which operate to direct the thread into the eye and prevent it from passing elsewhere.

The Most Rational Source of Power

(Concluded from page 334.)

The value of the whole group of inventions lies in these sun heat absorbers, which generate the steam required to run the engine from the sun's rays.

These heat absorbers and steam generators are, in this particular plant, five in number. They are each 200 feet long and 13 feet wide at the top. They consist of parabolic frames of very light structural iron set with mirrors in such a manner that these mirrors catch the sun's light and reflect it all on the two sides of the long boilers suspended in that portion of the frame where the sun's light converges. Every five square feet of sunlight received by the mirrors are focused thereby upon one square foot of the boilers, thus quintupling the light power. However, as the steam pressure is not allowed to go over atmospheric pressure (equal to 212 deg. Fahr.) the temperature of the boilers never goes above 212 deg. Fahr. and the excess heat is transmitted into the water and produces great volumes of low-pressure steam.

The boilers are flat bottomed, and along the top of each runs a 3½-inch diameter steam pipe, which gathers the steam along the whole line and carries it from each of the boilers into the main steam pipe through which it goes to the engine.

The boilers are constructed of cast iron in the present plant, but in future plants will be stamped quickly and cheaply in pieces 12 feet long from steel tubes one eighth inch thick.

The steam after passing through the engine and doing its work is condensed into water and pumped again into the boilers. Thus the same water is used over and over again, and only the very little needed to compensate for accidental leakage is added. As practically no new water is used there is no danger from the boilers becoming clogged with mud or scale.

High-pressure steam up to 300 pounds per square inch can be generated by these heat absorbers, but this is not done, mainly because at the high temperature of this steam too much heat would be lost by conduction and convection into the surrounding air, and secondly, because, were high-pressure steam used, the boilers would have to be very strongly constructed, and cost considerably more money, and necessitate heavier frame construction to carry them than is now the case.

The five heat absorbers carrying the boilers are set in line due north and south on rollers and gears carried on proper foundation posts of concrete, and are turned slowly from an eastern aspect in the morning to a western aspect in the evening, so that at all times of the day they exactly face the sun, and generate steam.

The very important element of expansion and contraction was carefully considered in the construction of the heat absorbers, and many trials were made before all the disturbances were eliminated.

The boilers are covered with a single thickness of window glass to prevent loss of heat.

Sun power can be generated in large plants located in the desert on the border of arable land, and the power transmitted by electricity over large areas.

The construction of the Egyptian sun power plant is particularly simple, and thoroughly practical in every way. Any common engineer can run it. Owing to the fact that ordinary materials are used in its construction, repairs can be easily made and everything is above ground and readily accessible.

The Ten Greatest Inventions

(Concluded from page 339.)

resulted in a protest from a number of readers who misunderstood our object in publishing the list, and called us to account for including in it many inventions that did not fall within the rules of the contest. However, the majority of our readers evidently understood that we did not indorse all of the inventions in the list, and the result of their vote is very interesting. As in the case of the con-

(Continued on page 352.)

testants there was a wide diversity of opinion, the vote was not unanimous even on *wireless telegraphy!* The following is the result of the vote reduced to a percentage basis:

Wireless telegraphy	97 per cent
Aeroplane	75 " "
X-Ray machine	74 " "
Automobile	66 " "
Motion pictures	63 " "
Reinforced concrete	37 " "
Phonograph	37 " "
Incandescent electric lamp	35 " "
Steam turbine	34 " "
Electric car	34 " "
Calculating machine	33 " "
Internal combustion engine	33 " "
Radium	27 " "
Submarine boats	24 " "
Picture telegraphy	24 " "
Electric furnace	21 " "
Diesel engine	18 " "
Color photography	17 " "
Dictograph	16 " "
Composing machine	15 " "
Transmission and transforming of alternating current	15 " "
Pneumatic tire	15 " "
Dirigible	13 " "
Photo-engraving	13 " "
Tungsten	11 " "
Electric welding	10 " "
High speed steel	10 " "
Kodak	10 " "
Fixation of nitrogen	9 " "
Welsbach burner	9 " "
Producer gas	8 " "
Monorail	8 " "
Flexible photo films	7 " "
Liquid air	7 " "

There was a straggling vote for the other subjects in the list. Burbank's work received 23 votes, Pasteur's work 20 votes, Acetylene Gas from Carbide, 17; Mercury Vapor, Lamp, 7; and the Preservation of Sugar Producing Plants, 7. In addition to this there were about 60 inventions mentioned which did not appear in our list. The more important of these were the Combined Motion Picture and Talking Machine, 10 votes; Edison's Storage Battery, 6 votes; Automatic Player Piano, 4 votes; Pulmotor, 4 votes; and Telephone, 4 votes; while the rest were nearly all represented by a single vote each.

Evidently there is not much disagreement about the first five inventions in the list, but after that there is a sudden drop from 63 per cent to 37. It is interesting to compare this vote with the list in the first prize essay. Mr. Wyman's selection of Wireless Telegraphy is indorsed by 97 per cent vote, his Aeroplane by 75 per cent vote, the Automobile by 66 per cent vote, Motion Pictures by 63 per cent vote, the Turbine by 34 per cent vote, Electric Furnace by 21 per cent vote, the Composing Machine by only 15 per cent vote, while the Cyanide Process, the Induction Motor, and Electric Welding received scarcely any attention from the readers at large. On the other hand, the X-Ray Machine which polled such a high vote with the readers was entirely ignored by Mr. Wyman.

After all is he not right in rejecting the X-Ray Machine? What is there to the machine but a Crookes tube and a Ruhmkorff coil, both old inventions? Is it not the discovery of the rays rather than the machine that is of an epochal character? But discoveries not patentable are expressly excluded from the contest. What about radium then? Surely the process of producing radium involves invention. Why is it not patentable? Why is not radium chloride patentable just as are other chemical compounds? Even such subjects as the aeroplane and automobile are open to question. The judges had to consider the question of whether the internal combustion motor was not really the pioneer invention to which credit should be given for the automobile and aeroplane. In other words, is not the aeroplane merely a kite with a motor in it and is not the automobile an ordinary carriage equipped with mechanical power? The whole subject is one full of question, and consequently of exceedingly great interest.

The Heavens in November

(Concluded from page 341.)

The last two lines, having been derived by extrapolation, may be in error by a small amount.

This means that the comet will be about half way between ε Cygni and the northern stars of Delphinus on November 1st, about 3 degrees west of ε Cygni on the 17th, and about midway between ε and α Cygni on the 25th. It will therefore be very easy to find. Metcalf's comet has been passing southward through the same region of the sky, and, on the evening of October 22nd, the two comets, according to the ephemerides, came within 40 minutes of one another—in the same low-power telescopic field—an occurrence so unusual as to deserve mention, though unfortunately the predictions were not published in time to enable advance notice of it to be given in this column.

The Heavens.

The stars which serve as sky marks in finding Westphal's comet may be found on our map, well down in the west and northwest, though early in the evenings they will be much higher up. Below Cygnus is Lyra, and Ursa Major and Draco are also low along the northern horizon, while Cassiopeia swings high above the pole. The splendid winter constellations have come full into view in the east and southeast—Auriga, Gemini and Taurus, Orion and the Great and Little Dogs. Perseus, Andromeda and Pegasus form a line stretching westward through the zenith, while Cetus, Eridanus and Aquarius occupy the great dull region in the south and southwest.

The Planets.

Mercury is evening star until the 23rd, when he passes through inferior conjunction and becomes a morning star. At the beginning of the month he can just be seen in the twilight, setting at 5:50 P. M., and he is visible again at its end, just in the dawn, rising at 5:40 A. M.

Venus is a morning star, rising about 5 A. M., and still fairly conspicuous. Mars is in Gemini, south of Castor and Pollux and rises about 9:20 P. M. on the 1st, and 7:40 on the 30th. He nearly doubles in brightness during the month, and exceeds all the stars except Sirius.

Jupiter is evening star in Sagittarius, dropping fast into the twilight. He sets at 8:45 at the beginning, and at 7:20 at the close of the month.

Saturn is in Taurus, just approaching opposition, and rises at 6 P. M. in the middle of the month. He appears fully as bright as Capella, and but little fainter than Mars. Uranus is evening star in Capricornus, too low in the west to be well seen. Neptune is right opposite in the heavens, on the borders of Gemini and Cancer, and can be observed in the morning hours.

The Moon.

First quarter occurs at 1:34 P. M. on the 5th, full Moon at 6 P. M. on the 13th, last quarter at 2:57 A. M. on the 21st, and new Moon at 8:41 P. M. on the 27th. The Moon is nearest us on the 9th, and farthest off on the 25th. She is in conjunction with Jupiter on the 3rd, Uranus on the 4th, Saturn on the 15th, Mars and Neptune on the 18th, Venus on the 26th, Mercury on the 27th, and Jupiter again on the 30th—none of the apparent approaches being at all close.

Princeton University Observatory.

A Cinematograph Hand Camera

(Concluded from page 346.)

cycle pump in the same manner as if pneumatic tires were being inflated, the camera being placed upon the ground for the purpose. The charging valve is placed upon the top and is closed with a screw cap to prevent the entrance of dust. About forty strokes with an average foot pump is sufficient to produce a pressure of about 100 pounds in the reservoirs, and pumping can be continued as long as desired, the cylinders being designed to withstand a pressure of 2,000 pounds per square inch. As it is physically impossible for a person to charge the cylinders

above 500 pounds, an ample margin of safety is provided. Charging the cylinders is an absolutely simple, straightforward process, the only precaution necessary being a pause of about 30 seconds after each 100 pounds pressure is attained so as to permit the pump and connection to cool down.

The film boxes are mounted side by side, the unexposed box being placed in the innermost position. The film is threaded through the intermittent mechanism in the usual manner and returned into the exposed film box mounted beside the first box, and upon the same spindle. The gyroscope, though small, is of great power, and by its means all small vibrations, such as that produced by the running of the mechanism, the speedy movement of a vehicle, and so forth, are completely absorbed.

In operation the camera is held up on the chest so that the view finder is brought level with the eye, like a rifle sight, and in this way one is able to follow the scene, keeping the main features in the center of the picture, with the utmost ease. Both hands are free to hold the instrument during exposures, as it is not necessary to keep the finger upon the button. When all is ready for exposure the air valve is opened by turning a small knob. This permits the compressed air to pass to the motor. The latter is not self-starting and the air is unable to escape. Then, sighting the camera, the starting button is depressed and given a sharp turn. This sets the motor in motion, and it will continue running until a slight pressure is imparted to the button once more, when the mechanism stops immediately. Thus one has complete control over the camera, and in photographing topical subjects no waste of film need be incurred. While it is not necessary to close the air valve upon completing each exposure, this precaution should be observed when work is completed, or when the film box requires changing. Although the normal speed of exposure is sixteen pictures per second, this speed may be varied even while the camera is being used, and the eye is sighting through the view finder, merely by moving the speed regulator.

The governing system is very positive and insures that the same ratio of exposures and speed of the gyroscope is maintained when the reservoirs are nearly exhausted as when fully charged.

This camera has been embraced by several well-known cinematographers such as Cherry Kearton, Paul Rainey, and others, who make a special study of making motion pictures of big game in the jungle, where the conditions render the use of the orthodox cumbersome instrument extremely dangerous. It has also been adopted for photographing from aeroplanes, for which work, where the conditions are cramped, it is well adapted. It is also extremely useful for work in crowded thoroughfares. In this case a street procession or other incident may be taken without the operator's securing an elevated position to clear the heads of the people. He merely holds the aeroscope above his head with his two hands, and by means of a special view finder placed on the under side of the camera, he can follow the incidents and make the exposures. It is also applicable to studio work in conjunction with the ordinary tripod, the mechanical automatic control and drive being very useful at times.

Air Scouting at the Italian Maneuvers

"THE characteristic note of the Italian grand cavalry maneuvers held toward the end of September in the vast Lombard plain was undoubtedly the effective work done by the aerial exploration service," writes the Italian correspondent of the *Engineer* to his journal.

"Sixteen aeroplanes, equally apportioned between the red and blue armies, took part in the proceedings. They were divided into four squadrons and had at their disposal a service of motor cycles and repairing shops mounted on military motor

chassis. Four Blériot monoplanes and four Maurice Farman biplanes were allotted to the red army, while an equal number of the latter machines were assigned to the blue forces, together with four Nieuport monoplanes. Each unit was managed by a pilot and an 'observer.'

"The results were eminently satisfactory, nor was the work interrupted by the persistent rains, heavy clouds, and strong winds. On one occasion two Blériot monoplanes were sent to reconnoitre and returned after two and a half hours, bringing back photographs and precise information which enabled the commander of the red army to determine the numbers, formation, positions, and movements of the entire *Vercelli*—blue—division then marching on Milan from Piacenza and Pavia. One of the machines had flown 300 kilometers (187 miles), or 120 kilometers (74.5 miles) per hour. This speed represents, in the opinion of the officers of the biplane section, an almost excessive limit for accurate observation. Those gentlemen, in fact, hold that the biplane, traveling at 100 kilogrammes (62 miles) per hour, is the ideal machine for military work, since it has the advantage of maximum stability and offers greater facilities to the pilot for seeing immediately beneath him.

"The airship performances seem to have been what many expected. Their demerits appear to have been brought out on more than one occasion, when the heavier craft was seriously menaced by its more active rivals.

"In view of the fact that knowledge of the various types of aeroplanes is not as yet generally diffused, and in order to prevent confusion between friend and foe, the military authorities adopted the simple plan of distributing leaflets with rough indications of the salient points and outline sketches of the different aeroplanes taking part in the maneuvers. The Maurice Farman biplanes which served with the 'red' forces were marked to distinguish them from those of the opposing side, with a large black circle and another in white under the wings."

The South American Meat Industry

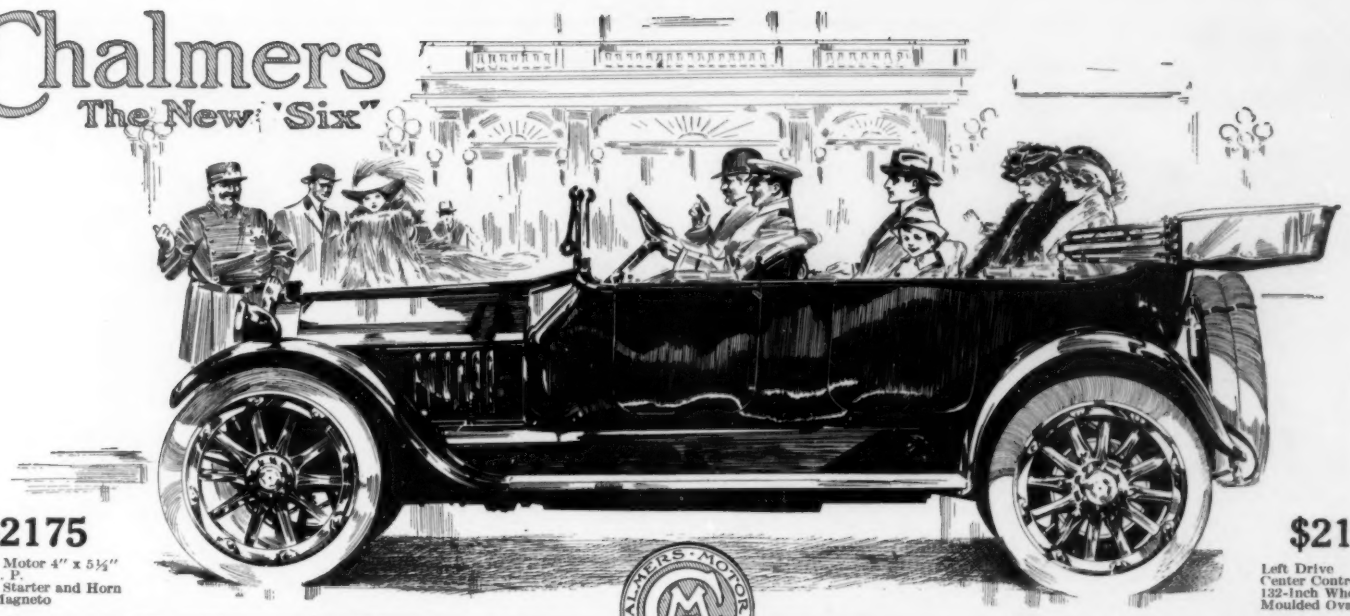
THE stock-raising and meat industries of South America are well developed and have large possibilities for future extension, according to Dr. A. D. Melvin, chief of the Bureau of Animal Industry, who has returned from a tour of investigation made by direction of the Secretary of Agriculture.

While statistics show that Argentina is already slaughtering up to the limit of its present stock of cattle, Dr. Melvin was impressed with the great resources of that country for cattle raising and believes that it will be possible for the stock raisers to bring about a large increase in the meat output if present prices are maintained.

The cattle slaughtered for export in Argentina, Dr. Melvin says, are fed no grain whatever, but are raised and fattened entirely on alfalfa pastures. For the most part the cattle are high-grade stock, the predominating breed being the Durham, with the Hereford ranking second and the Polled Angus third in number. The alfalfa pastures are capable of supporting many more cattle than are the native "camps" or unbroken country. In a general way the cattle raisers estimate on 2½ acres of pasture per head for growing cattle, and 3 to 3½ acres for fattening cattle. These pastures support the cattle the year round without any further feeding except in occasional times of drouth or invasion of locusts.

"At the time of my visit," says Dr. Melvin, "cattle that dressed 820 pounds were sold for $74.80 gold. This grade of Argentine beef, which is of very high quality, is selling in England for from 8 to 9 cents a pound wholesale. Besides the price received for the meat there is a considerable return from the hide and the offal, and since the entrance of American packers into the South American trade these by-products are being carefully prepared and utilized.

Chalmers
The New "Six"



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This is the Day of the "Six"

No one ever goes back to a "Four" after driving a New Chalmers "Six."

Because no "Four" can ride as easy, live as long or live as cheaply. Let's find out why.

Try to Match It

Run the New "Six" up a long hill. Creep it through a crowd. Send it through the deep sand or where the going is rough.

Then ask the maker of any "Four" to duplicate its silent, flexible power—its freedom from vibration, its lack of stress and effort.

You'll know then why the new "Six" will live to serve you long after a "Four" has been discarded.

Yet the New "Six" costs but a trifle more than a "Four" at the start and far less in the end.

The New "Six" Lasts Longer

The interval between explosions in a "Four" produces a vibration that knocks ceaselessly at the life of the car. There's no escaping it. No auxiliary gearing can overcome it.

The explosions of the New "Six" give a continuous push to the pistons. There's no interval—no gap in the power stream. This even pull—this absence of vibration gives a smoothness no "Four" can equal; a smoothness that spells economy.

For vibration means wear—renewals. It is the chief enemy of endurance. The absence of it means long life and low upkeep.

The Hare and the Tortoise in One

With the New "Six" you can do nearly everything on high gear. You can idle down to a tortoise-like crawl in a crowd and then at the touch of the throttle away with the speed of the hare. Gear shifting is rarely required.

This unusual flexibility is all in the motor itself. There's no need to weigh down the New "Six" with supplementary gear mechanism.

Facts About Fuel Economy

Everyone knows that, other conditions being equal, it requires the same amount of fuel to develop a given horse-power whether it be delivered from four cylinders or from six.

The difference is that each cylinder of the "Four" must do one half more work, and consequently must consume one half more gasoline, than each cylinder of the "Six."

Judge for yourself which will run smoother and last longer; which will be easier on the car and easier on the passengers.

A New Factor in Safety

The motor of the New Chalmers "Six" can't be stalled. It can never "go dead" in crowded traffic nor fail you under sudden overload.

The silent Chalmers-Entz electric starter won't allow the motor to stop even should the gas be cut off. Simply release the clutch and it keeps the motor running until it picks up again.

The starter is always ready. You don't have to give it a thought. It gives you that sensation of security that is the very essence of motoring pleasure.

Saving Gasoline Money

Low grade gasoline requires more heat to turn it into gas than the better grades. So in the New "Six" we heat the fuel in three ways: a jacket of hot air and one of hot water about the carburetor and a full jacket of hot water about the manifold where the gas enters the cylinders. Every atom instantly is turned into power by this extra heat. Not a drop is wasted. This means a tremendous saving in a season's fuel bills.

Beauty That's More Than Skin Deep

The low-hung chassis—the long wheel base—the under-slung springs cushion the bumps of the roughest road; yet they give to the New "Six" the lithe and speedy grace of the thoroughbred.

The oval fenders sit so close not a drop of mud can reach you, while their long graceful sweep completes the stream-line effect of the roomy bodies.

So all the distinctive features of the New "Six" are more than merely beautiful; they mean greater utility as well.

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This IS the day of the "Six." The New Chalmers "Six" was announced August 28 We were prepared for a rush of orders. But nothing like the actual demand.

Our $7,000,000 factory has been unable to build "Sixes" as fast as the public wants them. We have more orders on our books for winter delivery than for any other model we ever built.

For people want the New Chalmers "Six"; they are willing to take delivery whenever they can get cars.

Now that for a few dollars more than the price of a four, you can have all the advantages of the New "Six," it seems a pity that anyone should be disappointed through delay in placing his order.

We cannot tell you in words of the virtues of the New "Six." You must see it in action. Your dealer is ready to take you on the Chalmers Standard Road Test now. See him today and, when the car has won you, be wise and place your order immediately.

Roadster	**$2175**	**Six Passenger**	**$2275**
Four Passenger	**2175**	**Coupe**	**2850**
Five Passenger	**2175**	**Limousine**	**3600**

All bodies interchangeable. Five wire wheels $80 extra

Fully equipped f. o. b. Detroit

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Will the lather be abundant?

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Contains
Holder-Top Shaving Stick
Shaving Cream
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